

## Interlaboratory Proficiency Test 02/2021

# Natural water analyses

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Mika Sarkkinen, Keijo Tervonen, Sari Lanteri,  
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## Abstract

## Interlaboratory Proficiency Test 02/2021

ProfTest SYKE carried out the proficiency test (PT) for analysis of chlorophyll *a*, colour, conductivity, nutrients, pH and turbidity in natural waters in February-March 2021. In total, there were 34 participants in the PT. Either the calculated concentration or the robust mean, the mean or the median of the reported results was used as the assigned values for the measurands. The overall performance of the participants was evaluated by using z scores. In this PT 90 % of the results were satisfactory when total deviation of 0.2 pH units for pH values and 5–35 % for the other measurands was accepted from the assigned value. Warm thanks to all participants in this proficiency test!

**Keywords:** water analysis, chlorophyll *a*, colour, conductivity,  $N_{NH_4}$ ,  $N_{NO_2+NO_3}$ ,  $N_{tot}$ ,  $P_{PO_4}$ ,  $P_{tot}$ , pH, turbidity, water and environmental laboratories, proficiency test, interlaboratory comparison

## Tiivistelmä

**Laboratorioiden välinen pätevyyskoe 02/2021**

Proffest SYKE järjesti helmi-maaliskuussa 2021 pätevyyskokeen luonnonvesien klorofylli *a*, ravinne-, pH-, sameus-, sähkönjohtavuus- ja värimääryyksille. Pätevyyskokeeseen osallistui yhteensä 34 laboratorioita. Testisuureiden vertailuarvoina käytettiin joko laskennallista pitoisuutta tai osallistujien tulosten robustia keskiarvoa, keskiarvoa tai mediaania. Osallistujien pätevyys arviointi tehtiin z-arvojen avulla. Koko tulosaineistossa oli 90 % hyväksyttäviä tuloksia, kun vertailuarvosta sallittiin pH-määrittäyksissä 0,2 pH-yksikön ja muissa määrittäyksissä 5–35 %:n poikkeama. Kiitos pätevyyskokeen osallistujille!

**Asiasanat:** vesianalyysi, klorofylli *a*, pH, sähkönjohtavuus ( $\gamma_{25}$ ),  $N_{NH_4}$ ,  $N_{NO_2+NO_3}$ ,  $N_{tot}$ ,  $P_{PO_4}$ ,  $P_{tot}$ , sameus, väri, vesi- ja ympäristölaboratoriot, pätevyyskoe, laboratorioden välinen vertailumittaus

## Sammandrag

## Provningsjämförelse 02/2021

Under februari-mars 2021 genomförde Profitest SYKE en provningjämförelse, som omfattade bestämningen av klorofyll *a*, färg, näringsämnen, ledningsförmåga, grumlighet och pH i naturvatten. Denna jämförelse hade totalt 34 deltagarna. Som referensvärde av analytens koncentration användes antingen det teoretiska värdet eller robust medelvärdet, medelvärdet eller median av deltagarnas resultat. Resultaten värderades med hjälp av z-värden. I denna jämförelse var 90 % av resultaten värderades med z-värden acceptabla. Resultatet var acceptabelt, om det devierade mindre än 0,2 pH enhet eller 5–35 % från referensvärdet. Ett varmt tack till alla deltagarna i testet!

**Nyckelord:** vattenanalyser, klorofyll *a*, färg, N<sub>NH4</sub>, N<sub>NO2+NO3</sub>, N<sub>tot</sub>, P<sub>PO4</sub>, P<sub>tot</sub>, pH, ledningsförmåga, grumlighet, provningsjämförelse, vatten- och miljölaboratorier





## Contents

<b>1 Introduction .....</b>	<b>7</b>
<b>2 Organizing the proficiency test .....</b>	<b>7</b>
2.1 Responsibilities .....	7
2.2 Participants .....	7
2.3 Samples and delivery .....	8
2.4 Homogeneity and stability studies .....	8
2.5 Feedback from the proficiency test .....	9
2.6 Processing the data .....	9
2.6.1 Pretesting the data .....	9
2.6.2 Assigned values .....	9
2.6.3 Proficiency assessment procedure .....	10
<b>3 Results and conclusions .....</b>	<b>10</b>
3.1 Results .....	10
3.2 Analytical methods .....	12
3.3 Uncertainties of the results .....	14
<b>4 Evaluation of the results .....</b>	<b>15</b>
<b>5 Summary .....</b>	<b>16</b>
<b>6 Summary in Finnish .....</b>	<b>16</b>
<b>References .....</b>	<b>17</b>
Appendix 1. Participants in the proficiency test .....	18
Appendix 2. Sample preparation .....	19
Appendix 3. Homogeneity of the samples .....	20
Appendix 4. Stability of the samples .....	21
Appendix 5. Feedback from the proficiency test .....	23
Appendix 6. Evaluation of the assigned values and their uncertainties .....	25
Appendix 7. Terms and definitions used in performance evaluation .....	26
Appendix 8. Results of each participant .....	27
Appendix 9. Results of participants and their uncertainties .....	43
Appendix 10. Summary of the z scores .....	55
Appendix 11. z scores in ascending order .....	57
Appendix 12. Results grouped according to the methods .....	68
Appendix 13. Examples of measurement uncertainties reported by the participants .....	80





# 1 Introduction

Profest SYKE carried out the proficiency test (PT) for analysis of chlorophyll *a*, colour, conductivity, nutrients ( $N_{NH4}$ ,  $N_{NO2+NO3}$ ,  $N_{tot}$ ,  $P_{PO4}$ ,  $P_{tot}$ ), pH and turbidity in brackish and river waters in February-March 2021 (NW 02/2021). In the PT the results of laboratories providing measurements of the natural waters were evaluated.

Finnish Environment Institute SYKE is appointed National Reference Laboratory in the environmental sector in Finland. The duties of the reference laboratory include providing interlaboratory proficiency tests and other comparisons for analytical laboratories and other producers of environmental information. This proficiency test has been carried out under the scope of the SYKE reference laboratory and it provides an external quality evaluation between laboratory results, and mutual comparability of analytical reliability. The proficiency test was carried out in accordance with the international standard ISO/IEC 17043 [1] and applying ISO 13528 [2] and IUPAC Technical report [3]. Profest SYKE is accredited by the Finnish Accreditation Service as a proficiency testing provider (PT01, ISO/IEC 17043, [www.finas.fi/sites/en](http://www.finas.fi/sites/en)). The organizing of this proficiency test is included in the accreditation scope of Profest SYKE.

## 2 Organizing the proficiency test

### 2.1 Responsibilities

#### Organizer

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#### The responsibilities in organizing the proficiency test

Mirja Leivuori	coordinator
Riitta Koivikko	substitute for coordinator
Päivi Grönroos	substitute for coordinator
Keijo Tervonen	technical assistance
Markku Ilmakunnas	technical assistance
Sari Lanteri	technical assistance
Ritva Väisänen	technical assistance

**Analytical expert** Mika Sarkkinen, SYKE

**Expert laboratory** SYKE, Oulu (T003, [www.finas.fi/sites/en](http://www.finas.fi/sites/en))

### 2.2 Participants

In total 34 laboratories participated in this PT (Appendix 1), 30 from Finland and 4 from abroad. 85 % of the participants reported that they have accredited quality management system based on ISO/IEC 17025, and 9 % have quality management system according to ISO 9000 series. Altogether 85 % of the participants used accredited analytical methods at least for a part of the measurements. For this PT, the expert laboratory has code 6 in the result tables.

## 2.3 Samples and delivery

Three types of samples were delivered to the participants: synthetic samples and brackish as well as river water samples for analysis of chlorophyll *a*, colour, conductivity,  $N_{NH_4}$ ,  $N_{NO_2+NO_3}$ ,  $N_{tot}$ ,  $P_{PO_4}$ ,  $P_{tot}$ , pH and turbidity.

When preparing the samples, the purity of the used sample vessels was controlled. The randomly chosen sample vessels were filled with deionized water and the purity of the sample vessels was controlled after three days by analysing  $P_{PO_4}$ ,  $N_{NH_4}$  or conductivity for phosphoric, nitrogen, and other compounds, respectively. According to the test results all used vessels fulfilled the purity requirements.

The synthetic samples were mainly prepared by diluting from reagents produced by Merck or by BDH Prolabo. The synthetic samples A1N and A1P for ammonium nitrogen ( $N_{NH_4}$ ), sum of nitrate and nitrite nitrogen ( $N_{NO_2+NO_3}$ ), total nitrogen ( $N_{tot}$ ), phosphate phosphorus ( $P_{PO_4}$ ) and total phosphorus ( $P_{tot}$ ) analysis were prepared from the NIST traceable reference solutions. The brackish water was collected from the shore of the coastal area of the Gulf of Finland in Kirkkonummi and the river water sample was collected from the River Mustionjoki, Finland. The sample preparation is described in more detail in Appendix 2.

The samples were delivered on 15 February 2021 to some of the participants (abroad and national) and on 16 February 2021 to the main part of the national participants. The samples arrived to the participants mainly on 17 February 2021. One participant received the samples on 18 February 2021.

The samples were to be measured as follows:

chlorophyll <i>a</i>	18 February 2021
conductivity, pH	18 February 2021
$N_{NH_4}$ , $N_{NO_2+NO_3}$ , $P_{PO_4}$	18 February 2021
colour, turbidity	18 February 2021
$N_{tot}$ , $P_{tot}$	latest on 1 March 2021

The results were to be reported at the latest on 2 March 2021 and all participants delivered the results accordingly. The preliminary result report was delivered to the participants via ProfTestWEB and email on 5 March 2021.

## 2.4 Homogeneity and stability studies

The homogeneity of the samples was tested by analysing alkalinity,  $N_{NH_4}$ ,  $N_{tot}$ ,  $P_{tot}$ , and pH. More detailed information of homogeneity test is shown in Appendix 3. According to the homogeneity test results, all samples were considered homogenous.

The stability of the samples was tested by analysing pH,  $N_{NH_4}$ , and  $P_{PO_4}$  from the samples stored at the room temperature for one day. The measurement values were checked against the results of the samples stored at 4 °C. According to the test results, the concentration of  $P_{PO_4}$  in sample B2P could slightly decrease in the samples, if their temperature increased during the sample distribution. However, no correlation between the performance of the participants and elevated temperatures was observed. Thus, the samples were regarded stable under the sample distribution conditions (Appendix 4).

The temperature control sample was placed into the sample package and the temperature was requested to be measured immediately after opening the package. The temperature of the control sample was

mainly  $\leq 12$  °C, and only one participant reported higher temperature. It is crucial to measure the temperature of the control sample soon after the sample package has arrived.

## 2.5 Feedback from the proficiency test

The feedback from the proficiency test is shown in Appendix 5. The comments from the participants focused mainly on sample delivery or reporting of results. The comments from the provider are mainly related to the lacking compliance with the given instructions and to incorrect reporting. All the feedback from the proficiency test is valuable and is exploited when improving the activities.

## 2.6 Processing the data

### 2.6.1 Pretesting the data

To test the normality of the data the Kolmogorov-Smirnov test was applied. The outliers were rejected according to the Hampel or the Grubbs test before calculating the mean. The results which differed from the data more than  $5 \times s_{\text{rob}}$  or 50 % from the robust mean, were rejected before the statistical results handling. If the result has been reported as below detection limit, it has not been included in the statistical calculations.

The participants were to report replicate results for the  $N_{\text{NH}_4}$ ,  $N_{\text{NO}_2+\text{NO}_3}$ ,  $N_{\text{tot}}$ ,  $P_{\text{PO}_4}$  and  $P_{\text{tot}}$  measurements. The replicate results were tested using the Cochran's test, which compares the within-laboratory deviation of each participant to the standard deviation of the replicate results of all the participants. The replicate results which differ significantly from others are outliers. The Cochran's test rejects the results having significantly higher within-laboratory deviation than the results the average, regardless their z score evaluation. When two results were to be reported for the analysis and the participant reported only one, the result was not included in the statistical calculations and it was not evaluated.

More information about the statistical handling of the data is available from the Guide for participant [4].

### 2.6.2 Assigned values

The NIST traceable calculated values were used as the assigned values for  $N_{\text{NH}_4}$ ,  $N_{\text{NO}_2+\text{NO}_3}$ ,  $N_{\text{tot}}$ ,  $P_{\text{PO}_4}$ , and  $P_{\text{tot}}$  in the synthetic samples. For the other measurands and samples the robust mean, the mean (Colour<sub>visual</sub>: N3S) or the median (Colour<sub>visual</sub>: A1V, B2S and Colour<sub>spectrophotometric</sub>: B2S,  $n_{\text{stat}} < 12$ ) of the results reported by the participants was used as the assigned value (Appendix 6).

**After reporting the preliminary results report the assigned value of Colour<sub>visual</sub> in the sample N3S has changed from 35 mg/l to 37 mg/l. This change has caused no changes in the participants' performance evaluation, but changes in the numerical values of z scores has occurred. After reporting the preliminary results no other changes have been done for the assigned values.**

The assigned values based on the robust mean, the mean or the median are not metrologically traceable values. As it was not possible to have metrologically traceable assigned values, the best available values were selected to be used as the assigned values. The reliability of the assigned values was statistically tested [2, 3].

For the calculated assigned values, the expanded uncertainty ( $k=2$ ) was evaluated by using standard uncertainties associated with individual operations involved in the preparation of the sample. The main

individual source of the uncertainty was the purity of the stock compound. When the robust mean, the mean or the median of the results reported by the participants was used as the assigned value, the uncertainty was calculated using the robust standard deviation or the standard deviation [2, 4].

The uncertainty of the calculated assigned values was  $\leq 1.3\%$  (at the 95 % confidence level). After reporting the preliminary results report the uncertainty of the assigned value of  $P_{PO_4}$  A1P was recalculated, and the value changed from 1.3 % to 0.7 % (Appendix 6). When using the robust mean, the mean or the median of the participant results as the assigned value, the uncertainties of the assigned values varied between 0.2 % and 13 %. Detailed information of the assigned values, their uncertainties and reliability are shown in Appendix 6.

### 2.6.3 Proficiency assessment procedure

The standard deviation for proficiency assessment was estimated based on the measurand concentration, the results of homogeneity and stability tests, the uncertainty of the assigned value, and the long-term variation in the former proficiency tests. The standard deviation for proficiency assessment ( $2 \times s_{pt}$  at the 95 % confidence level) was set for pH measurements to 0.2 pH units and for the other measurements from 5 % to 35 % depending on the measurands. **After reporting the preliminary results report no changes have been done for the standard deviations of the proficiency assessment values.**

When using the robust mean, the mean or the median as the assigned value, the reliability was tested according to the criterion  $u_{pt} / s_{pt} \leq 0.3$ , where  $u_{pt}$  is the standard uncertainty of the assigned value and  $s_{pt}$  is the standard deviation for proficiency assessment [2, 3]. When testing the reliability of the assigned value the criterion was mainly fulfilled and the assigned values were considered reliable.

The reliability of the standard deviation for proficiency assessment ( $s_{pt}$ ) and the corresponding z score was estimated by comparing  $s_{pt}$  with the robust standard deviation ( $s_{rob}$ ) or standard deviation ( $s$ ) of the reported results [3]. The uniformity criterion  $s_{rob}$  (or  $s$ )/ $s_{pt} \leq 1.2$  was mainly fulfilled.

In the following cases, the criterion for the reliability of the assigned value<sup>1</sup> and/or for the reliability of the standard deviation<sup>2</sup> were not met and, therefore, the evaluation of the performance is weakened in this proficiency test:

Sample	Measurand
A1V	Colour <sub>visual</sub> <sup>1</sup>
B2S	Turbidity <sup>1,2</sup>

## 3 Results and conclusions

### 3.1 Results

The summary of the results is presented in Table 1. The terms in the results table are explained in Appendix 7. The results and the performance of each participant are presented in Appendix 8 and the reported results with their expanded uncertainties ( $k=2$ ) are presented in Appendix 9. The summary of the z scores is shown in Appendix 10 and z scores in the ascending order in Appendix 11.

The robust standard deviation ( $s_{rob}$  %) for chlorophyll *a*, Colour<sub>visual</sub>, conductivity,  $N_{NO_2+NO_3}$  and pH in synthetic samples was below 4.0 % (Table 1). In general,  $s_{rob}$  % was lower than 10 % for 79 % of the reported results (Table 1). The maximum robust standard deviation ( $s_{rob, max}$ ) of the results was 22 %, which was slightly lower than in the previous similar proficiency test NW 02/2019 ( $s_{rob, max}$  33 %) [5].

Table 1. The summary of the results in the proficiency test NW 02/2021.

Measurand	Sample	Unit	Assigned value	Mean	Rob. mean	Median	$s_{\text{rob}}$	$s_{\text{rob}} \%$	$2 \times s_{\text{pt}} \%$	$n_{\text{all}}$	Acc z %
Chlorophyll a	A1K	abs/cm	0.16	0.16	0.16	0.16	<0.01	2.3	10	15	87
	B2K	$\mu\text{g/l}$	11.7	11.7	11.7	11.6	0.4	3.6	15	14	86
	N3K	$\mu\text{g/l}$	24.0	24.0	24.0	24.3	1.2	5.2	15	14	100
Colour <sub>visual</sub>	A1V	mg/l, Pt	25	24	25	25	<0.01	<0.01	15	12	75
	B2S	mg/l, Pt	10	9	10	10	2	18.2	35	10	70
	N3S	mg/l, Pt	37	37	37	38	4	9.4	20	12	83
Colour <sub>Spectrophotometric</sub>	A1V	mg/l, Pt	22.3	22.4	22.3	22.5	1.4	6.3	15	14	100
	B2S	mg/l, Pt	8.83	9.0	9.0	8.8	1.6	18.3	35	11	91
	N3S	mg/l, Pt	36.5	36.9	36.5	36.1	4.7	12.8	25	14	79
Conductivity 25	A1J	mS/m	9.31	9.33	9.31	9.33	0.21	2.3	5	27	81
	B2H	mS/m	1000	1000	1000	1005	21	2.1	5	21	81
	N3H	mS/m	11.5	11.5	11.5	11.5	0.2	1.9	5	26	88
$\text{N}_{\text{NH}_4}$	A1N	$\mu\text{g/l}$	15	15.6	15.8	15.5	1.7	11.0	20	25	81
	B2N	$\mu\text{g/l}$	39.9	39.6	39.9	39.0	4.1	10.4	20	18	88
	N3N	$\mu\text{g/l}$	65.5	65.4	65.5	65.0	4.1	6.3	15	23	95
$\text{N}_{\text{NO}_2+\text{NO}_3}$	A1N	$\mu\text{g/l}$	126	130	130	130	5	3.9	8	22	90
	B2N	$\mu\text{g/l}$	218	219	218	215	17	8.0	15	17	81
	N3N	$\mu\text{g/l}$	355	355	355	361	17	4.7	10	20	95
$\text{N}_{\text{tot}}$	A1N	$\mu\text{g/l}$	170	172	176	170	20	11.5	20	21	89
	B2N	$\mu\text{g/l}$	508	507	508	513	35	6.9	15	18	88
	N3N	$\mu\text{g/l}$	777	778	777	780	35	4.5	10	20	100
pH	A1H		7.28	7.29	7.28	7.29	0.03	0.5	2.7	30	100
	B2H		8.21	8.21	8.21	8.21	0.08	0.9	2.4	24	96
	N3H		7.86	7.86	7.86	7.86	0.09	1.2	2.5	26	96
$\text{P}_{\text{PO}_4}$	A1P	$\mu\text{g/l}$	11.3	11.0	11.0	11.3	1.1	9.6	10	21	74
	B2P	$\mu\text{g/l}$	25.4	25.5	25.4	25.5	1.8	7.1	15	17	94
	N3P	$\mu\text{g/l}$	20.0	20.0	20.0	20.7	1.7	8.5	15	19	94
$\text{P}_{\text{tot}}$	A1P	$\mu\text{g/l}$	25.0	25.2	25.3	25.1	1.9	7.5	15	25	91
	B2P	$\mu\text{g/l}$	32.2	32.3	32.2	31.6	2.6	8.0	15	20	94
	N3P	$\mu\text{g/l}$	43.6	43.6	43.6	43.2	2.3	5.2	10	23	90
Turbidity	A1S	FNU	3.07	3.05	3.07	3.08	0.16	5.3	15	24	92
	B2S	FNU	0.19	0.19	0.19	0.19	0.04	21.6	30	19	81
	N3S	FNU	3.39	3.39	3.39	3.40	0.18	5.3	15	23	100

Rob. mean: the robust mean,  $s_{\text{rob}}$ : the robust standard deviation,  $s_{\text{rob}} \%$ : the robust standard deviation as percent,  $2 \times s_{\text{pt}} \%$ : the standard deviation for proficiency assessment at the 95 % confidence level,  $n_{\text{all}}$ : the number of the participants, Acc z %: the results (%), where  $|z| \leq 2$ .

In this PT the participants were to report replicate results for nutrient measurements. The repeatability of the replicate results was tested using ANOVA statistical handling (Table 2). The estimation of the robustness of the methods could be done by the ratio  $s_b/s_w$ . For the robust methods the ratio  $s_b/s_w$  should not exceed 3. The robustness criterion was fulfilled for 33 % of the tested measurements (Table 2).

Table 2. The summary of repeatability based on replicate determinations (ANOVA statistics).

Measurand	Sample	Unit	Assigned value	Mean	$s_w$	$s_b$	$s_t$	$s_w\%$	$s_b\%$	$s_t\%$	$s_b/s_w$
$N_{NH4}$	A1N	$\mu g/l$	15	15.6	0.435	2.41	2.45	2.7	15	15	5.6
	B2N	$\mu g/l$	39.9	39.6	0.654	4.46	4.51	1.6	11	11	6.8
	N3N	$\mu g/l$	65.5	65.4	0.811	5.44	5.50	1.2	8.2	8.3	6.7
$N_{NO2+NO3}$	A1N	$\mu g/l$	126	130	1.97	4.32	4.75	1.5	3.3	3.7	2.2
	B2N	$\mu g/l$	218	219	1.81	20.8	20.9	0.83	9.5	9.6	11
	N3N	$\mu g/l$	355	355	2.59	16.8	17.0	0.73	4.7	4.8	6.5
$N_{tot}$	A1N	$\mu g/l$	170	172	17.6	25.1	30.6	9.8	14	17	1.4
	B2N	$\mu g/l$	508	507	7.95	35.5	36.4	1.6	7.0	7.2	4.5
	N3N	$\mu g/l$	777	778	7.91	32.8	33.8	1.0	4.2	4.3	4.2
$P_{PO4}$	A1P	$\mu g/l$	11.3	11.0	0.379	0.910	0.986	3.4	8.3	8.9	2.4
	B2P	$\mu g/l$	25.4	25.5	0.318	1.83	1.86	1.2	7.2	7.3	5.7
	N3P	$\mu g/l$	20.0	20.0	1.31	1.18	1.77	6.6	5.9	8.8	0.90
$P_{tot}$	A1P	$\mu g/l$	25.0	25.2	0.514	2.07	2.13	2.0	8.1	8.4	4.0
	B2P	$\mu g/l$	32.2	32.3	0.647	2.37	2.46	2.0	7.3	7.6	3.7
	N3P	$\mu g/l$	43.6	43.6	0.996	2.14	2.36	2.3	4.9	5.4	2.2

Ass.val.: assigned value;  $s_w$ : repeatability standard error;  $s_b$ : between participants standard error;  $s_t$ : reproducibility standard error.

### 3.2 Analytical methods

The participants could use different analytical methods for the measurements in the PT. The used analytical methods and results of the participants grouped by methods are shown in more detail in Appendix 12. The statistical comparison of the analytical methods was possible for the data where the number of the results was  $\geq 5$ .

#### Chlorophyll *a*

The participants (14 – 15, depending on the sample) determined chlorophyll *a* by spectrophotometry using e.g. the standard method SFS 5772 (Appendix 12).

#### Colour

Determination of colour was grouped into two groups: visual comparator method using a comparator (Colour<sub>Visual</sub>) and spectrophotometric method (Colour<sub>Spectrophotometric</sub>). Methods based on standard EN ISO 7887 (10 – 11 participants, depending on the sample) and on withdrawn standard method SFS 3023 (one participant) were used for Colour<sub>Visual</sub>. Spectrophotometric method (EN ISO 7887) was used by 11 – 14 participants, depending on the sample (Appendix 12). For Colour<sub>Visual</sub> the scale for visual comparator method is stepped, and, thus, the results are not normally distributed and the performance evaluation for Colour<sub>Visual</sub> results is only approximate. No statistically significant differences were observed between the used methods.

#### Conductivity 25

The participants measured conductivity mostly by using the standard method EN 27888 (Appendix 12). One participant used continuous conductivity measurement by conductometry.

#### Ammonium nitrogen $N_{NH4}$

Most participants (6 – 8, depending on the sample) determined ammonium nitrogen using the automatic standard method EN ISO 11732 or using the corresponding manual method SFS 3032 (6 – 8 participants, depending on the sample). Depending on the sample, one or two participants used the spectrophotometric salicylate method modified for Aquachem technique and 3 – 5 participants (depending on the

sample) used some other method, for example fluorometric method (CFA) or tube method (Appendix 12). No statistically significant differences were observed between the used methods.

#### **Sum of nitrate and nitrite nitrogen $N_{NO2+NO3}$**

Participants determined sum of nitrate and nitrite nitrogen mostly using the standard method EN ISO 13395 (12 – 15 participants, depending on the sample). Both IC-method (EN ISO 10304) and spectrophotometric determination (SFS 3030) were used by one participant. The sulfanilamide spectrophotometric method after hydrazine reduction modified for Aquachem technique was used by 2 participants. Other used methods were tube method and sulfanilamide methods using Cd/Cu or VC13 reduction (1 – 2 participants, depending on the sample, Appendix 12).

#### **Total nitrogen $N_{tot}$**

Most participants (9 – 10, depending on the sample) determined total nitrogen according to the standard method EN ISO 11905. One participant used tube method while 6 – 8 participants (depending on the sample) used some other method, for example based on standards ISO 29441 (4 participants) or EN 12260 (2 participants, Appendix 12). No statistically significant differences were observed between the used methods.

#### **pH**

Half of the participants (12 – 13, depending on the sample) measured pH using universal electrode and almost the other half (9 – 11, depending on the sample) used an electrode for low ionic waters. Other electrode types (Tris electrodes 924030 and continuous potentiometric measurement) were used by 1 – 2 participant depending on the sample (Appendix 12). No statistically significant differences were observed between the used methods.

#### **Phosphate phosphorus $P_{PO4}$**

Phosphate phosphorus was determined using the standard method EN ISO 15681 (Automatic (CFA, FIA) ammonium molybdate method) by 8 – 10 participants, depending on the sample. The withdrawn Finnish standard method 3025 was used by 1 – 3 participants, depending on the sample. Depending on the sample the ammonium molybdate spectrophotometric method modified for Aquachem technique was used by 2 – 3 the participants and 4 participants used the standard method EN ISO 6878 (manual spectrophotometric method, Appendix 12). Based on visual evaluation, no significant differences were observed.

#### **Total phosphorus $P_{tot}$**

Total phosphorus was measured using the standard method EN ISO 15681 (automatic ammonium molybdate method) by 7 – 9 participants, depending on the sample, and the standard method EN ISO 6878 (manual ammonium molybdate) was used by 7 participants. The withdrawn standard method SFS 3026 was used by 1 – 3 participants, depending on the sample. Ammonium molybdate method modified for Aquachem technique was used by 1 – 2 participants (depending on the sample), one participant used ICP-AES and one participant used ICP-MS (Appendix 12). No statistically significant differences were observed between the used methods.

#### **Turbidity**

The participants measured turbidity mostly with an apparatus based on diffuse radiation measurement (15–23 participants, depending on the sample). One participant used other method, continuous IR-measurement technique (Appendix 12).



### 3.3 Uncertainties of the results

Altogether 91 % of the participants reported the expanded uncertainties ( $k=2$ ) with their results for at least some of their results (Table 3, Appendix 13). The range of the reported uncertainties varied between the measurands and the sample types.

Several approaches were used for evaluating the measurement uncertainty (Appendix 13). The participants mainly used the internal quality control (IQC) data and the results obtained in proficiency tests or the IQC data from both synthetic control samples and routine sample replicates. (Appendix 13). Depending on the sample and measurand, up to nine participants used MUKIT measurement uncertainty software for the estimation of their uncertainties [6]. The free software is available on the webpage: [www.syke.fi/envical/en](http://www.syke.fi/envical/en) [6, 7]. Generally, the used approach for estimating measurement uncertainty did not make definite impact on the uncertainty estimates.

In order to promote the enhancement of environmental measurements' quality standards and traceability, the national quality recommendations for the data entered into the water quality registers have been published in Finland [8]. The recommendations for measurement uncertainties for the tested measurands in natural waters vary from 5 % to 20 % (for pH measurement 0.2 pH units, see Table 3). In this proficiency test some of participants had their measurement uncertainties within these limits, while some did not achieve them. It was evident, that for pH and turbidity some uncertainties had been reported erroneously, not as relative values (%) as the PT organizer had requested (Table 3). Within the optimal measuring range, the expanded measurement uncertainty ( $k=2$ ) should typically be 20 – 40 %. Close to the limit of quantification the relative measurement uncertainty is higher. Further, the expanded uncertainties below 5 % could commonly be considered unrealistic uncertainty value for routine laboratories. Harmonization of the uncertainties estimation should be continued.

Table 3. The ranges of the reported expanded uncertainties by participants as percent ( $k=2$ ,  $U_i\%$ ) and quality criterion for natural waters published by Finnish Environment Institute [8].

Measurand	Synthetic sample, $U_i\%$	Brackish water, $U_i\%$	River water, $U_i\%$	Recommendation, % [8]
Chlorophyll <i>a</i>	10 – 27	10 – 27	10 – 27	20
Colour <sub>Visual</sub>	5 – 32	5 – 50	5 – 32	20
Colour <sub>Spectrophotometric</sub>	10 – 37	10 – <b>63</b> <sup>1)</sup>	10 – 37	20
Conductivity 25	2 – 8	2 – 8	2 – 10	5
$N_{NH_4}$	9 – 37	10 – 31	6 – 31	15
$N_{NO_2+NO_3}$	6 – 22	7 – 22	6 – 20	15
$N_{tot}$	8 – 33	8 – 23	8 – 23	15
pH	<b>0.2</b> – 5	<b>0.04</b> – 5	<b>0.2</b> – 5	0.2 pH units (A1H 2.7 %, B2H 2.4 %, N3H 2.5 %)
$P_{PO_4}$	10 – 30	10 – 25	10 – 25	15
$P_{tot}$	11 – 35	11 – 35	11 – 25	15
Turbidity	<b>0.1</b> – 31	<b>0.1</b> – <b>82</b>	<b>0.1</b> – 31	20

<sup>1)</sup> In table with bold the values of expanded measurement uncertainty <1% and >50 %.

## 4 Evaluation of the results

The performance evaluation of the participants was based on the z scores, which were calculated using the assigned values and the standard deviation for proficiency assessment (Appendix 7). The z scores were interpreted as follows:

Criteria	Performance
$ z  \leq 2$	Satisfactory
$2 <  z  < 3$	Questionable
$ z  \geq 3$	Unsatisfactory

In total, 90 % of the results were satisfactory when total deviation of 0.2 pH units and for the other measurement 5–35 % from the assigned values were accepted. The summary of the performance evaluation and comparison to the previous performance is presented in Table 4. In the previous similar PT, NW 02/2019, the performance was satisfactory for 85 % of the participant results with the same range of standard deviation for proficiency assessment [5].

Table 4. Summary of the performance evaluation in the proficiency test NW 02/2021.

Measurand	$2 \times s_{pt}\%$	Satisfactory results, %	Remarks
Chlorophyll a	10 – 15	91	Good performance. Excellent performance (100 %) for the sample A1K. In the PT NW 02/2019 the performance was satisfactory for 85 % of the results when deviation of 10 – 20 % from the assigned value was accepted [5].
Colour <sup>Visual</sup>	15 – 35	76	The performance evaluation for the sample A1V is only approximate. In the PT NW 02/2019 the performance was satisfactory for 73 % of the results when deviation of 20 – 35 % from the assigned value was accepted [5].
Colour <sup>Spectrophotometric</sup>	15 – 35	90	Good performance. Excellent performance (100 %) for the sample A1V. In the PT NW 02/2019 the performance was satisfactory for 89 % of the results with the same range of standard deviation for proficiency assessment [5].
Conductivity 25	5	83	In the PT NW 02/2019 the performance was satisfactory for 79 % of the results when deviation of 5 – 8 % from the assigned value was accepted [5].
N <sub>NH4</sub>	15 – 20	88	In the PT NW 02/2019 87 % of the results were satisfactory when deviation of 20 % from the assigned value was accepted [5].
N <sub>NO2+NO3</sub>	8 – 15	89	In the PT NW 02/2019 the performance was satisfactory for 88 % of the results with the same range of standard deviation for proficiency assessment [5].
N <sub>tot</sub>	10 – 20	92	Good performance. Excellent performance (100 %) for the sample N3N. In the PT NW 02/2019 the performance was satisfactory for 85 % of the results when deviation of 15 – 20 % from the assigned value was accepted [5].
pH	2.4 – 2.7 (0.2 pH units)	97	Excellent performance. In the PT NW 02/2019 the performance was satisfactory for 95 % of the results [5].
P <sub>PO4</sub>	10 – 15	87	In the PT NW 02/2019 the performance was satisfactory for 83 % of the results with the same range of standard deviation for proficiency assessment [5].
P <sub>tot</sub>	10 – 15	92	Good performance. In the PT NW 02/2019 the performance was satisfactory for 89 % of the results with the same range of standard deviation for proficiency assessment [5].
Turbidity	15 – 30	91	Good performance. Excellent performance (100 %) for the sample N3S. The performance evaluation for the samples B2S is only approximate. In the PT NW 02/2019 the performance was satisfactory for 78 % of the results when deviation of 20 – 30 % from the assigned value was accepted [5].

## 5 Summary

Profest SYKE carried out the proficiency test (PT) for analysis of chlorophyll *a*, colour, conductivity, nutrients ( $N_{NH_4}$ ,  $N_{NO_2+NO_3}$ ,  $N_{tot}$ ,  $P_{PO_4}$ ,  $P_{tot}$ ), pH and turbidity in natural waters in February-March 2021 (NW 02/2021). Three types of samples were delivered to the participants: synthetic samples as well as brackish and river water samples. In total, 34 laboratories participated in this proficiency test.

The calculated concentration (NIST traceable) or the robust mean, the mean or the median of the results reported by the participants was used as the assigned value for the measurands. The uncertainties of the assigned values were estimated at the 95 % confidence level ( $k=2$ ) and they were  $\leq 1.3$  % for the calculated values and 0.2–13 % for the other assigned values.

The performance evaluation was based on the *z* scores. In total, 90 % of the reported results were satisfactory when the total deviation of 0.2 pH units for pH values and 5–35 % for the other measurands was accepted from the assigned value at the 95 % confidence level. Altogether 85 % of the participants used accredited analytical methods at least for a part of the measurements and 90 % of those results were satisfactory.

## 6 Summary in Finnish

Profest SYKE järjesti luonnonvesiä analysoiville laboratorioille pätevyyskokeen helmi-maaliskuussa 2021 (NW 02/2021). Pätevyyskokeessa määritettiin alkaliniteetti, ravinteet ( $N_{NH_4}$ ,  $N_{NO_2+NO_3}$ ,  $N_{tot}$ ,  $P_{PO_4}$ ,  $P_{tot}$ ), pH, sameus ja sähkönjohtavuus synteettisestä näytteestä sekä rannikko- ja jokivesinäytteistä. Pätevyyskokeeseen osallistui yhteensä 34 laboratoriota.

Testisuureen vertailuarvona käytettiin laskennallista pitoisuutta (synteettinen näyte, NIST jäljitettävä), osallistujien tulosten robustia keskiarvoa, keskiarvoa tai mediaania. Vertailuarvon laajennettu epävarmuus arvioitiin 95 %:n luottamusvälillä ( $k=2$ ) ja se oli  $\leq 1.3$  % laskennallisille vertailuarvoille ja 0.2–13 % muille vertailuarvoille.

Osallistujien pätevyys arvioitiin *z*-arvojen avulla. Koko tulosaineistossa oli *z*-arvoilla arvioituna 90 % hyväksyttäviä tuloksia, kun vertailuarvosta sallittiin pH-määrittelyssä 0,2 pH-yksikön ja muissa määrittelyissä 5–35 %:n poikkeama. Osallistujista 85 % ilmoitti tuloksensa akkreditoituna ainakin joidenkin määrittelysten osalta, ja heidän tuloksistaan hyväksyttäviä oli 90 %.

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## Appendix I. Participants in the proficiency test

Country	Participant
<b>Denmark</b>	Eurofins Milj A/S, Vejen, Denmark
<b>Estonia</b>	Tallinn University of Technology, Department of Marine Systems
<b>Finland</b>	EHP Environment Oy Eurofins Ahma Oy Seinäjoki Eurofins Ahma Oy, Rovaniemi Eurofins Environment Testing Finland Oy, Lahti HSY Käyttölaboratorio Pitkälampi Helsinki HY, Tvärminnen eläintieteellinen asema, Hanko KVVY Tutkimus Oy, Tampere KVVY-Botnialab, Vaasa Kymen Ympäristölaboratorio Oy Lounais-Suomen vesi- ja ympäristötutkimus Oy, Turku Luonnonvarakeskus, Viikki B2-laboratorio LUVVYLab Oy Ab MetropoliLab Oy Neste Oyj, AQC, Vesilaboratorio, Kulloo Oulun Vesi Liikelaitos Saimaan Vesi- ja Ympäristötutkimus Oy, Lappeenranta Savo-Karjalan Ympäristötutkimus Oy, Joensuu Savo-Karjalan Ympäristötutkimus Oy, Kuopio ScanLab Oy SeiLab Oy Haapaveden toimipiste SeiLab Oy Seinäjoen toimipiste SGS Finland Oy, Kotka SSAB Europe Raahe, Raahe SYKE Oulun toimipaikka SYKE, Helsingin toimipaikka SYKE/Merikeskus SYNLAB Analytics & Services Finland Oy Tampereen Vesi/Viemärlaitoksen laboratorio Yara Suomi Oy, Uusikaupunki ÅMHM laboratoriet, Jomala, Åland
<b>Sweden</b>	Stockholm University, ACES Umeå Marine Sciences Centre

## Appendix 2. Sample preparation

Measurand	Sample	Initial concentration	Added compound (Producer) Addition	Assigned value
<b>Chlorophyll a</b> [abs/cm] [µg/l]	A1K	-	Chlorophyll a 3 mg (Sigma) / 1.5 litres ethanol	0.16
	B2K	0.7	10.45	11.7
	N3K	0.5	22.80	24.0
<b>Colour</b> [mg/l, Pt]	A1V	-	Platinum Cobalt-solution (Merck) 24.0	25/22.3
	B2S	10	-	10/8.83
	N3S	40	-	35/36.5
<b>Conductivity 25</b> [mS/m]	A1J	-	KCl (Merck) 7.70	9.31
	B2H	1090	-	1000
	N3H	11.0	-	11.5
<b>N<sub>NH4</sub></b> [µg/l]	A1N	-	NH <sub>4</sub> Cl (Merck) 15.0	15
	B2N	0	26	39.9
	N3N	9	55	65.5
<b>N<sub>NO2+NO3</sub></b> [µg/l]	A1N	-	NaNO <sub>3</sub> (Merck) 126.0	126
	B2N	165	-	218
	N3N	328	-	355
<b>N<sub>tot</sub></b> [µg/l]	A1N	-	NaNO <sub>3</sub> + NH <sub>4</sub> Cl + Na <sub>2</sub> -EDTA (Merck) 169.9	170
	B2N	473	499	508
	N3N	762	817	777
<b>pH</b> pH unit	A1H	-	Buffer solution pH 7.0 (BDH Prolabo) 7.5	7.28
	B2H	8.0	-	8.21
	N3H	7.0	-	7.86
<b>P<sub>PO4</sub></b> [µg/l]	A1P	-	KH <sub>2</sub> PO <sub>4</sub> (Merck) 11.25	11.3
	B2P	28.6	-	25.4
	N3P	9.3	14.7	20.0
<b>P<sub>tot</sub></b> [µg/l]	A1P	-	KH <sub>2</sub> PO <sub>4</sub> + C <sub>3</sub> H <sub>7</sub> Na <sub>2</sub> O <sub>6</sub> P (Merck) 25.85	25.0
	B2P	37.1	-	32.2
	N3P	22.5	50.3	43.6
<b>Turbidity</b> [FNU]	A1S	-	Hach Formazin 3.16	3.07
	B2S	0.8	-	0.19
	N3S	5.7	-	3.39

First letter of the sample code indicates the sample matrix:

A = Synthetic sample

B = Brackish water

N = Natural water (river water)

### Appendix 3. Homogeneity of the samples

Homogeneity was tested as replicate measurements of selected measurement from six samples of each sample types.

#### Criteria for homogeneity

$$s_a/s_{pt} < 0.5$$

$$s_{sam}^2 < c, \text{ where}$$

$s_{pt}$  = standard deviation for testing of homogeneity

$s_{anal}$  = analytical deviation, standard deviation of the results in a sub sample

$s_{sam}$  = between-sample deviation, standard deviation of results between sub samples

$$c = F1 \times s_{all}^2 + F2 \times s_{anal}^2, \text{ where}$$

$$s_{all}^2 = (0.3 \times s_{pt})^2$$

F1 and F2 are constants of F distribution derived from the standard statistical tables for the tested number of samples [2,3].

Measurand/Sample	Concentration [µg/l] [pH-unit] [FNU] [mg/l, Pt]	n	Spt %	Spt	Sanal	Sanal/Spt	Sanal/Spt < 0.5?	s <sub>sam</sub> <sup>2</sup>	c	s <sub>sam</sub> <sup>2</sup> < c?
Colour/B2S	10.0	4	17.5	1.75	0	0	Yes	0	0.72	Yes
Colour/N3S	40.0	4	10	4.00	0	0	Yes	0	3.75	Yes
N <sub>NH4</sub> /B2N	35.7	6	10	3.57	0.75	0.21	Yes	0.64	3.50	Yes
N <sub>NH4</sub> /N3N	59.1	6	7.5	4.43	1.08	0.24	Yes	0	5.89	Yes
N <sub>tot</sub> /B2N	513	6	7.5	38.5	3.00	0.08	Yes	13.5	310	Yes
N <sub>tot</sub> /N3N	804	6	5	40.2	3.60	0.09	Yes	14.5	344	Yes
pH/B2H	8.17	8	1.2	0.10	0.004	0.04	Yes	0.0001	0.002	Yes
pH/N3H	7.89	8	1.25	0.10	0.03	0.26	Yes	0	0.003	Yes
P <sub>tot</sub> /B2P	29.9	6	7.5	2.24	0.45	0.20	Yes	0.08	1.34	Yes
P <sub>tot</sub> /N3P	42.8	6	5	2.14	0.50	0.23	Yes	0.23	1.33	Yes
Turbidity/B2S	0.19	3	15	0.03	0.01	0.49	Yes	0	0.001	Yes
Turbidity/N3S	3.60	4	7.5	0.27	0.04	0.14	Yes	0.002	0.02	Yes

n=number of test samples,  $s_{pt}$  % = standard deviation for proficiency testing

#### Criterion for homogeneity:

$$s_{sam}/s_{pt} < 0.5, \text{ where}$$

$s_{pt}$  = standard deviation for proficiency assessment

$s_{sam}$  = between-sample deviation, standard deviation of results between sub samples

Measurand/Sample	Concentration [µg/l]	n	Spt %	Spt	S <sub>sam</sub>	S <sub>sam</sub> /Spt	S <sub>sam</sub> /Spt < 0.5?
Chlorophyll a/B2K	11.7	8	7.5	0.88	0.20	0.23	Yes
Chlorophyll a/N3K	24.9	8	7.5	1.87	0.45	0.24	Yes

**Conclusion:** All criteria for homogeneity were fulfilled and the samples could be considered homogenous.



## Appendix 4. Stability of the samples

The samples were delivered on 15 or 16 February 2021 and they arrived to the participants mainly on 17 February 2021. The samples were to be analysed as follows:

chlorophyll <i>a</i>	18 February 2021
pH, conductivity	18 February 2021
N <sub>NH4</sub> , N <sub>NO2+NO3</sub> , P <sub>PO4</sub>	18 February 2021
colour, turbidity	18 February 2021
N <sub>tot</sub> , P <sub>tot</sub>	at the latest on 1 March 2021

Stability of chlorophyll *a*, pH, N<sub>NH4</sub> and P<sub>PO4</sub> was tested by analysing the samples stored at the temperatures 4 °C and 20 °C.

**Criterion for stability:**  $D < 0.3 \times s_{pt}$ , where

$D$  = |the difference of results measured from the samples stored at the temperatures 4 °C and 20 °C|

$s_{pt}$  = standard deviation for proficiency assessment

### Chlorophyll *a*

Sample	Result, abs/cm		Sample	Result, µg/l		Sample	Result, µg/l	
Date	18.2. (20 °C)	18.2. (4 °C)	Date	18.2. (20 °C)	18.2. (4 °C)	Date	18.2. (20 °C)	18.2. (4 °C)
A1K	0.162	0.163	B2K	11.60	11.83	N3K	24.26	24.72
D	0.001		D	0.22		D	0.46	
0.3× $s_{pt}$	0.002		0.3× $s_{pt}$	0.26		0.3× $s_{pt}$	0.54	
	D < 0.3 × $s_{pt}$ ? Yes			D < 0.3 × $s_{pt}$ ? Yes			D < 0.3 × $s_{pt}$ ? Yes	

### N<sub>NH4</sub>

Sample	Result, µg/l		Sample	Result, µg/l		Sample	Result, µg/l	
Date	18.2. (20 °C)	18.2. (4 °C)	Date	18.2. (20 °C)	18.2. (4 °C)	Date	18.2. (20 °C)	18.2. (4 °C)
A1N	14.42	14.63	B2N	33.71	35.83	N3N	60.70	62.62
D	0.20		D	2.12		D	1.91	
0.3× $s_{pt}$	0.45		0.3× $s_{pt}$	1.20		0.3× $s_{pt}$	1.47	
	D < 0.3 × $s_{pt}$ ? Yes			D < 0.3 × $s_{pt}$ ? No <sup>1)</sup>			D < 0.3 × $s_{pt}$ ? No <sup>1)</sup>	

<sup>1)</sup> The difference is within the analytical error

### pH

Sample	Result		Sample	Result		Sample	Result	
Date	18.2. (20 °C)	18.2. (4 °C)	Date	18.2. (20 °C)	18.2. (4 °C)	Date	18.2. (20 °C)	18.2. (4 °C)
A1H	7.26	7.26	B2H	8.17	8.17	N3H	7.87	7.87
D	0.002		D	0.00		D	0.002	
0.3× $s_{pt}$	0.03		0.3× $s_{pt}$	0.03		0.3× $s_{pt}$	0.03	
	D < 0.3 × $s_{pt}$ ? Yes			D < 0.3 × $s_{pt}$ ? Yes			D < 0.3 × $s_{pt}$ ? Yes	

**P<sub>PO4</sub>**

Sample	Result, µg/l		Sample	Result, µg/l		Sample	Result, µg/l	
Date	18.2. (20 °C)	18.2. (4 °C)	Date	18.2. (20 °C)	18.2. (4 °C)	Date	18.2. (20 °C)	18.2. (4 °C)
<b>A1P</b>	11.60	11.58	<b>B2P</b>	23.72	26.16	<b>N3P</b>	20.81	19.66
D	0.02		D	2.45		D	1.15	
0.3×s <sub>pt</sub>	0.17		0.3×s <sub>pt</sub>	0.57		0.3×s <sub>pt</sub>	0.45	
	<b>D &lt; 0.3 × s<sub>pt</sub>? Yes</b>			<b>D &lt; 0.3 × s<sub>pt</sub>? No</b>			<b>D &lt; 0.3 × s<sub>pt</sub>? No <sup>1)</sup></b>	

<sup>1)</sup> The difference is within the analytical error

**Conclusion:** According to the test results, the concentration of P<sub>PO4</sub> in sample B2P could decrease if the temperature increased up to 20 °C during the sample transport and storage. Based on the reported arrival temperatures of the samples (see also Chapter 2.3), the maximum arrival temperature was 14.6 °C. Further, within the reported results there was no indication of temperature related decreased concentrations for the sample B2P. The other observed differences are within the analytical error. Overall, the samples were considered stable in the sample distribution conditions.

## Appendix 5. Feedback from the proficiency test

### FEEDBACK FROM THE PARTICIPANTS

Participant	Comments on technical execution	Action / Proftest SYKE
13	The samples were accidentally frozen by the participant.	A new N3H sample was delivered to the participant. The sample was analysed on 22 February 2021.
22	There was an extra sample in the package.	The organizer apologized this.
29	The temperature sample was missing from the sample package.	The organizer apologized this.

Participant	Comments to the results	Action / Proftest SYKE
1	The participant reported the results for turbidity in NTU unit.	The turbidity units NTU, FNU and FTU are all based on calibrations using the same formazin primary standards. There is numerical equivalence of the different unit.
5	The participant reported the result for chlorophyll <i>a</i> erroneously. The corrected result was: Sample A1K 0.16 abs/cm.	The result was outlier in the statistical treatment, and thus did not affect the performance evaluation.  If the result had been reported correctly, the result would have been satisfactory. The participant can re-calculate the z scores according to the Guide for participants [4].
12	The participant informed that they had reported the results for conductivity and Colour <sub>visual</sub> erroneously. The corrected results were: Conductivity: A1J 9.64 mS/m B2H 1013 mS/m N3H 12.1 mS/m Color <sub>visual</sub> : A1V 25 mg/l, Pt B2S 15 mg/l, Pt N3S 40 mg/l, Pt	In the final result evaluation, the participant result of Colour <sub>visual</sub> : N3S was removed and the assigned value changed from 35 to 37 mg/l.  The results of Colour <sub>visual</sub> : A1V, B2S and conductivity: A1J, B2H, N3H were outliers in the statistical treatment, and thus did not affect the performance evaluation.  If the participant's results had been reported correctly, the results of Colour <sub>visual</sub> : A1V, B2S and conductivity: A1J, B2H would have been satisfactory, and the results of Colour <sub>visual</sub> : N3H and conductivity: B2S would have been questionable. The participant can re-calculate the z scores according to the Guide for participants [4].

**FEEDBACK TO THE PARTICIPANTS**

<b>Participant</b>	<b>Comments</b>
1, 4, 17, 22	The participants reported only one result instead of the requested replicate results for one or more nutrient samples/measurands. Therefore, the performance evaluation is not done for these results. The participants should follow more carefully the instructions given by the provider.
5, 10, 12, 15, 24, 25, 26, 28, 30, 31, 32, 34	For one or more measurands and/or samples the variance of participant's replicate results was significantly higher than the variance of the other participants, i.e. those results were Cochran outliers. The provider recommends the participants to re-validate their accepted deviation of replicate measurements.
3, 23, 30, 33,	The participants did not report the expanded measurement uncertainties for some measurands as required. The measurement uncertainty should be reported with the results obtained with accredited method.
4, 6, 8, 10, 16, 17, 26, 27	The participant did not inform the accreditation status of their method for some measurands. The participants should follow the instructions of the organizer.
5, 15, 33, 34	Participants did not report the requested temperature of the control sample when opened the sample package. The provider recommends the participants to follow the given guidelines.
3, 7, 20, 30	The participants reported absolute measurement uncertainty for their pH and/or turbidity results, but the request from the organizer was to report the relative measurement uncertainty. The participant should follow the instructions of the organizer.
All	The uncertainty of the assigned value of $P_{PO_4}$ A1P was recalculated, and the value changed from 1.3 % to 0.7 %. The participants can re-calculate their zeta scores according to the Guide for participants [4].

## Appendix 6. Evaluation of the assigned values and their uncertainties

Measurand	Sample	Unit	Assigned value	$U_{pt}$	$U_{pt}, \%$	Evaluation method of assigned value	$u_{pt}/s_{pt}$
Chlorophyll <i>a</i>	A1K	abs/cm	0.16	<0.01	1.6	Robust mean	0.16
	B2K	µg/l	11.7	0.3	2.5	Robust mean	0.17
	N3K	µg/l	24.0	0.8	3.5	Robust mean	0.23
Colour <sub>Visual</sub>	A1V	mg/l, Pt	25	1	5.1	Median	0.34
	B2S	mg/l, Pt	10	1	9.9	Median	0.28
	N3S	mg/l, Pt	37	2	6.0	Mean	0.30
Colour <sub>Spectrophotometric</sub>	A1V	mg/l, Pt	22.3	0.9	4.2	Robust mean	0.28
	B2S	mg/l, Pt	8.83	0.9	10.2	Median	0.29
	N3S	mg/l, Pt	36.5	3.4	9.2	Robust mean	0.37
Conductivity 25	A1J	mS/m	9.31	0.11	1.2	Robust mean	0.23
	B2H	mS/m	1000	12	1.2	Robust mean	0.24
	N3H	mS/m	11.5	0.1	1.0	Robust mean	0.20
N <sub>NH4</sub>	A1N	µg/l	15	0.1	0.8	Calculated value	0.04
	B2N	µg/l	39.9	2.5	6.3	Robust mean	0.32
	N3N	µg/l	65.5	2.2	3.4	Robust mean	0.23
N <sub>NO2+NO3</sub>	A1N	µg/l	126	1	0.6	Calculated value	0.08
	B2N	µg/l	218	11	5.0	Robust mean	0.33
	N3N	µg/l	355	10	2.8	Robust mean	0.28
N <sub>tot</sub>	A1N	µg/l	170	1	0.8	Calculated value	0.04
	B2N	µg/l	508	23	4.5	Robust mean	0.30
	N3N	µg/l	777	21	2.7	Robust mean	0.27
pH	A1H		7.28	0.01	0.2	Robust mean	0.07
	B2H		8.21	0.04	0.5	Robust mean	0.21
	N3H		7.86	0.05	0.6	Robust mean	0.24
P <sub>PO4</sub>	A1P	µg/l	11.3	0.1	0.7	Calculated value	0.07
	B2P	µg/l	25.4	1.1	4.5	Robust mean	0.30
	N3P	µg/l	20.0	1.0	5.2	Robust mean	0.35
P <sub>tot</sub>	A1P	µg/l	25.0	0.3	1.3	Calculated value	0.09
	B2P	µg/l	32.2	1.5	4.7	Robust mean	0.31
	N3P	µg/l	43.6	1.2	2.8	Robust mean	0.28
Turbidity	A1S	FNU	3.07	0.09	2.8	Robust mean	0.19
	B2S	FNU	0.19	0.02	13.0	Robust mean	0.43
	N3S	FNU	3.39	0.09	2.8	Robust mean	0.19

$U_{pt}$  = Expanded uncertainty of the assigned value

Criterion for reliability of the assigned value  $u_{pt}/s_{pt} \leq 0.3$ , where

$s_{pt}$  = the standard deviation for proficiency assessment

$u_{pt}$  = the standard uncertainty of the assigned value

If  $u_{pt}/s_{pt} \leq 0.3$ , the assigned value is reliable.

## Appendix 7. Terms and definitions used in performance evaluation

The information could be applied according to the PT.

<b>Measurand</b>	The tested parameter
<b>Sample</b>	The code of the sample
<b>Assigned value</b>	The value attributed to a particular property of a proficiency test item
<b>Participant's result</b>	The result reported by the participant (when replicate results are reported, the mean value)
<b><math>2 \times s_{pt}</math> %</b>	The standard deviation for proficiency assessment ( $s_{pt}$ ) at the 95 % confidence level
<b>z score</b>	Used for the participant's performance evaluation in the PT. Calculated with formula:

$$z = (x_i - x_{pt})/s_{pt}, \text{ where}$$

$x_i$  = the result of the individual participant

$x_{pt}$  = the assigned value

$s_{pt}$  = the standard deviation for proficiency assessment

### Interpretation of the z scores

$ z  \leq 2$	Satisfactory
$2 <  z  < 3$	Questionable (warning signal), the result deviates more than $2 \times s_{pt}$ from the assigned value.
$ z  \geq 3$	Unsatisfactory (action signal), the result deviates more than $3 \times s_{pt}$ from the assigned value.

<b><math>E_n</math> score</b>	Error, normalized – Used to evaluate the difference between the assigned value and participant's result within their claimed expanded uncertainty. Calculated with formula:
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$$(E_n)_i = \frac{x_i - x_{pt}}{\sqrt{U_i^2 + U_{pt}^2}}, \text{ where}$$

$U_i$  = the expanded uncertainty of a participant's result

$U_{pt}$  = the expanded uncertainty of the assigned value

### Interpretation of the $E_n$ scores

$ E_n  \leq 1.0$	Satisfactory, should be taken as an indicator of successful performance when the uncertainties are valid.
$ E_n  > 1.0$	Unsatisfactory (action signal), could indicate a need to review the uncertainty estimates, or to correct a measurement issue.

<b>Md</b>	Median
<b>s</b>	Standard deviation
<b>s %</b>	Standard deviation, %
<b>n<sub>stat</sub></b>	Number of results in statistical processing

More information of the statistical calculations in international standards ISO/IEC 17043 and ISO 13528 as well as in Profest SYKE Guide for participants [1, 2, 4].

## Appendix 8. Results of each participant

Participant 1													
Measurand	Unit	Sample	<div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><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Participant 2													
Measurand	Unit	Sample	<div><div><div>-303</div><div></div></div></div>	z score	Assigned value	2×s <sub>pt</sub> %	Participant's result	Md	Mean	s	s %	n <sub>stat</sub>	
Conductivity 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# Appendix 8 (2/16)

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Measurand	Unit	Sample	<div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><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Participant 5												
Measurand	Unit	Sample	-3 0 3	z score	Assigned value	2*s <sub>pt</sub> %	Participant's result	Md	Mean	s	s %	n <sub>stat</sub>
Chlorophyll a	abs/cm	A1K		20.25	0.16	10	0.32	0.16	0.16	0.00	2.2	13
	µg/l	B2K		1.86	11.7	15	13.3	11.6	11.7	0.3	2.7	13
	µg/l	N3K		1.61	24.0	15	26.9	24.3	24.0	1.4	5.9	14
Colour <sub>Visual</sub>	mg/l, Pt	A1V		0.00	25	15	25	25	24	2	8.4	11
	mg/l, Pt	B2S		0.00	10	35	10	10	9	1	13.1	7
	mg/l, Pt	N3S		-0.54	37	20	35	38	37	3	9.4	10
Colour <sub>Spectrophotometric</sub>	mg/l, Pt	A1V		-1.38	22.3	15	20.0	22.5	22.4	1.3	6.0	14
	mg/l, Pt	B2S		-1.18	8.83	35	7.0	8.8	9.0	1.4	16.1	10
	mg/l, Pt	N3S		-0.55	36.5	25	34.0	36.1	36.9	5.2	14.0	12
Conductivity 25	mS/m	A1J		2.19	9.31	5	9.82	9.33	9.33	0.20	2.1	24
	mS/m	B2H		0.00	1000	5	1000	1005	1000	17	1.7	19
	mS/m	N3H		1.01	11.5	5	11.8	11.5	11.5	0.2	2.0	23
N <sub>NH4</sub>	µg/l	A1N		0.32	15	20	15.5	15.5	15.6	1.9	12.3	20
	µg/l	B2N		-0.70	39.9	20	37.1	39.0	39.6	3.6	9.2	17
	µg/l	N3N		-0.99	65.5	15	60.6	65.0	65.4	3.8	5.9	21
N <sub>NO2+NO3</sub>	µg/l	A1N		6.16	126	8	157	130	130	5	3.5	18
	µg/l	B2N		2.14	218	15	253	215	219	21	9.5	16
	µg/l	N3N		1.94	355	10	390	361	355	17	4.8	18
N <sub>tot</sub>	µg/l	A1N		5.10	170	20	257	170	172	15	8.7	16
	µg/l	B2N		0.18	508	15	515	513	507	36	7.1	15
	µg/l	N3N		1.72	777	10	844	780	778	33	4.3	18
pH		A1H		0.00	7.28	2,7	7.28	7.29	7.29	0.02	0.3	30
		B2H		0.30	8.21	2,4	8.24	8.21	8.21	0.07	0.9	23
		N3H		-0.71	7.86	2,5	7.79	7.86	7.86	0.10	1.2	26
P <sub>PO4</sub>	µg/l	A1P		1.22	11.3	10	12.0	11.3	11.0	0.9	8.6	18
	µg/l	B2P		0.51	25.4	15	26.4	25.5	25.5	1.8	7.2	16
	µg/l	N3P		0.44	20.0	15	20.7	20.7	20.0	1.5	7.5	17
P <sub>tot</sub>	µg/l	A1P		-0.52	25.0	15	24.0	25.1	25.2	1.7	6.7	21
	µg/l	B2P		-0.53	32.2	15	30.9	31.6	32.3	2.4	7.5	18
	µg/l	N3P		-0.73	43.6	10	42.0	43.2	43.6	2.3	5.2	21
Turbidity	FNU	A1S		0.17	3.07	15	3.11	3.08	3.05	0.14	4.6	23
	FNU	B2S		0.28	0.19	30	0.20	0.19	0.19	0.04	19.0	15
	FNU	N3S		-0.20	3.39	15	3.34	3.40	3.39	0.19	5.5	23

Participant 6												
Measurand	Unit	Sample	-3 0 3	z score	Assigned value	2*s <sub>pt</sub> %	Participant's result	Md	Mean	s	s %	n <sub>stat</sub>
Chlorophyll a	abs/cm	A1K		0.00	0.16	10	0.16	0.16	0.16	0.00	2.2	13
	µg/l	B2K		0.11	11.7	15	11.8	11.6	11.7	0.3	2.7	13
	µg/l	N3K		0.22	24.0	15	24.4	24.3	24.0	1.4	5.9	14
Colour <sub>Visual</sub>	mg/l, Pt	A1V		0.00	25	15	25	25	24	2	8.4	11
	mg/l, Pt	B2S		0.00	10	35	10	10	9	1	13.1	7
	mg/l, Pt	N3S		0.81	37	20	40	38	37	3	9.4	10
Conductivity 25	mS/m	A1J		-0.43	9.31	5	9.21	9.33	9.33	0.20	2.1	24
	mS/m	B2H		4.00	1000	5	1100	1005	1000	17	1.7	19
	mS/m	N3H		-0.35	11.5	5	11.4	11.5	11.5	0.2	2.0	23
N <sub>NH4</sub>	µg/l	A1N		-0.30	15	20	14.6	15.5	15.6	1.9	12.3	20
	µg/l	B2N		-1.13	39.9	20	35.4	39.0	39.6	3.6	9.2	17
	µg/l	N3N		-0.67	65.5	15	62.2	65.0	65.4	3.8	5.9	21

# Appendix 8 (4/16)

Participant 6												
Measurand	Unit	Sample	-3 0 3	z score	Assigned value	2×s <sub>pt</sub> %	Participant's result	Md	Mean	s	s %	n <sub>stat</sub>
N <sub>NO2+NO3</sub>	µg/l	A1N		0.12	126	8	127	130	130	5	3.5	18
	µg/l	B2N		-0.44	218	15	211	215	219	21	9.5	16
	µg/l	N3N		-0.45	355	10	347	361	355	17	4.8	18
N <sub>tot</sub>	µg/l	A1N		-0.44	170	20	163	170	172	15	8.7	16
	µg/l	B2N		-0.12	508	15	504	513	507	36	7.1	15
	µg/l	N3N		0.14	777	10	783	780	778	33	4.3	18
pH		A1H		-0.20	7.28	2,7	7.26	7.29	7.29	0.02	0.3	30
		B2H		-0.71	8.21	2,4	8.14	8.21	8.21	0.07	0.9	23
		N3H		-0.10	7.86	2,5	7.85	7.86	7.86	0.10	1.2	26
P <sub>PO4</sub>	µg/l	A1P		0.62	11.3	10	11.7	11.3	11.0	0.9	8.6	18
	µg/l	B2P		0.37	25.4	15	26.1	25.5	25.5	1.8	7.2	16
	µg/l	N3P		-0.30	20.0	15	19.6	20.7	20.0	1.5	7.5	17
P <sub>tot</sub>	µg/l	A1P		-0.53	25.0	15	24.0	25.1	25.2	1.7	6.7	21
	µg/l	B2P		-0.83	32.2	15	30.2	31.6	32.3	2.4	7.5	18
	µg/l	N3P		-0.94	43.6	10	41.6	43.2	43.6	2.3	5.2	21
Turbidity	FNU	A1S		0.56	3.07	15	3.20	3.08	3.05	0.14	4.6	23
	FNU	B2S		0.19	0.19	30	<0,3	0.19	0.19	0.04	19.0	15
	FNU	N3S		1.22	3.39	15	3.70	3.40	3.39	0.19	5.5	23

Participant 7												
Measurand	Unit	Sample	-3 0 3	z score	Assigned value	2×s <sub>pt</sub> %	Participant's result	Md	Mean	s	s %	n <sub>stat</sub>
Chlorophyll a	abs/cm	A1K		-0.25	0.16	10	0.16	0.16	0.16	0.00	2.2	13
	µg/l	B2K		-0.11	11.7	15	11.6	11.6	11.7	0.3	2.7	13
	µg/l	N3K		0.06	24.0	15	24.1	24.3	24.0	1.4	5.9	14
Colour <sub>Visual</sub>	mg/l, Pt	A1V		0.00	25	15	25	25	24	2	8.4	11
	mg/l, Pt	B2S		0.00	10	35	10	10	9	1	13.1	7
	mg/l, Pt	N3S		0.81	37	20	40	38	37	3	9.4	10
Colour <sub>Spectrophotometric</sub>	mg/l, Pt	A1V		0.24	22.3	15	22.7	22.5	22.4	1.3	6.0	14
	mg/l, Pt	B2S		-0.21	8.83	35	8.5	8.8	9.0	1.4	16.1	10
	mg/l, Pt	N3S		1.18	36.5	25	41.9	36.1	36.9	5.2	14.0	12
Conductivity 25	mS/m	A1J		0.56	9.31	5	9.44	9.33	9.33	0.20	2.1	24
	mS/m	B2H		0.08	1000	5	1002	1005	1000	17	1.7	19
	mS/m	N3H		0.35	11.5	5	11.6	11.5	11.5	0.2	2.0	23
N <sub>NH4</sub>	µg/l	A1N		0.20	15	20	15.3	15.5	15.6	1.9	12.3	20
	µg/l	B2N		1.28	39.9	20	45.0	39.0	39.6	3.6	9.2	17
	µg/l	N3N		1.88	65.5	15	74.8	65.0	65.4	3.8	5.9	21
N <sub>NO2+NO3</sub>	µg/l	A1N		1.29	126	8	133	130	130	5	3.5	18
	µg/l	B2N		-0.34	218	15	213	215	219	21	9.5	16
	µg/l	N3N		0.39	355	10	362	361	355	17	4.8	18
N <sub>tot</sub>	µg/l	A1N		1.94	170	20	203	170	172	15	8.7	16
	µg/l	B2N		0.45	508	15	525	513	507	36	7.1	15
	µg/l	N3N		0.69	777	10	804	780	778	33	4.3	18
pH		A1H		-0.92	7.28	2,7	7.19	7.29	7.29	0.02	0.3	30
		B2H		-1.02	8.21	2,4	8.11	8.21	8.21	0.07	0.9	23
		N3H		-0.31	7.86	2,5	7.83	7.86	7.86	0.10	1.2	26
P <sub>PO4</sub>	µg/l	A1P		0.71	11.3	10	11.7	11.3	11.0	0.9	8.6	18
	µg/l	B2P		0.21	25.4	15	25.8	25.5	25.5	1.8	7.2	16
	µg/l	N3P		0.67	20.0	15	21.0	20.7	20.0	1.5	7.5	17

Participant 7												
Measurand	Unit	Sample	-3 0 3	z score	Assigned value	2×s <sub>pt</sub> %	Participant's result	Md	Mean	s	s %	n <sub>stat</sub>
P <sub>tot</sub>	µg/l	A1P		-0.11	25.0	15	24.8	25.1	25.2	1.7	6.7	21
	µg/l	B2P		2.13	32.2	15	37.4	31.6	32.3	2.4	7.5	18
	µg/l	N3P		0.73	43.6	10	45.2	43.2	43.6	2.3	5.2	21
Turbidity	FNU	A1S		0.26	3.07	15	3.13	3.08	3.05	0.14	4.6	23
	FNU	B2S		0.19	0.19	30	< 0.2	0.19	0.19	0.04	19.0	15
	FNU	N3S		-0.04	3.39	15	3.38	3.40	3.39	0.19	5.5	23

Participant 8												
Measurand	Unit	Sample	-3 0 3	z score	Assigned value	2×s <sub>pt</sub> %	Participant's result	Md	Mean	s	s %	n <sub>stat</sub>
N <sub>NH4</sub>	µg/l	A1N		0.35	15	20	15.5	15.5	15.6	1.9	12.3	20
	µg/l	B2N		-0.24	39.9	20	38.9	39.0	39.6	3.6	9.2	17
N <sub>NO2+NO3</sub>	µg/l	A1N		0.71	126	8	130	130	130	5	3.5	18
	µg/l	B2N		-0.24	218	15	214	215	219	21	9.5	16
N <sub>tot</sub>	µg/l	A1N		0.51	170	20	179	170	172	15	8.7	16
	µg/l	B2N		0.12	508	15	513	513	507	36	7.1	15
pH		A1H		-1.83	7.28	2,7	7.10	7.29	7.29	0.02	0.3	30
		B2H		0.30	8.21	2,4	8.24	8.21	8.21	0.07	0.9	23
P <sub>PO4</sub>	µg/l	A1P		-0.12	11.3	10	11.2	11.3	11.0	0.9	8.6	18
	µg/l	B2P		0.82	25.4	15	27.0	25.5	25.5	1.8	7.2	16
P <sub>tot</sub>	µg/l	A1P		1.11	25.0	15	27.1	25.1	25.2	1.7	6.7	21
	µg/l	B2P		1.39	32.2	15	35.6	31.6	32.3	2.4	7.5	18

Participant 9												
Measurand	Unit	Sample	-3 0 3	z score	Assigned value	2×s <sub>pt</sub> %	Participant's result	Md	Mean	s	s %	n <sub>stat</sub>
Colour <sub>Visual</sub>	mg/l, Pt	A1V		0.00	25	15	25	25	24	2	8.4	11
	mg/l, Pt	B2S		0.00	10	35	10	10	9	1	13.1	7
	mg/l, Pt	N3S		0.81	37	20	40	38	37	3	9.4	10
Colour <sub>Spectrophotometric</sub>	mg/l, Pt	A1V		-0.78	22.3	15	21.0	22.5	22.4	1.3	6.0	14
	mg/l, Pt	B2S		-0.54	8.83	35	8.0	8.8	9.0	1.4	16.1	10
	mg/l, Pt	N3S		0.99	36.5	25	41.0	36.1	36.9	5.2	14.0	12
Conductivity 25	mS/m	A1J		0.90	9.31	5	9.52	9.33	9.33	0.20	2.1	24
	mS/m	B2H		0.20	1000	5	1005	1005	1000	17	1.7	19
	mS/m	N3H		0.52	11.5	5	11.7	11.5	11.5	0.2	2.0	23
N <sub>NH4</sub>	µg/l	A1N		1.70	15	20	17.6	15.5	15.6	1.9	12.3	20
	µg/l	B2N		0.44	39.9	20	41.7	39.0	39.6	3.6	9.2	17
	µg/l	N3N		-0.24	65.5	15	64.3	65.0	65.4	3.8	5.9	21
N <sub>NO2+NO3</sub>	µg/l	A1N		1.92	126	8	136	130	130	5	3.5	18
	µg/l	B2N		1.04	218	15	235	215	219	21	9.5	16
	µg/l	N3N		0.30	355	10	360	361	355	17	4.8	18
N <sub>tot</sub>	µg/l	A1N		-0.24	170	20	166	170	172	15	8.7	16
	µg/l	B2N		0.20	508	15	516	513	507	36	7.1	15
	µg/l	N3N		-0.47	777	10	759	780	778	33	4.3	18
pH		A1H		-0.20	7.28	2,7	7.26	7.29	7.29	0.02	0.3	30
		B2H		-1.02	8.21	2,4	8.11	8.21	8.21	0.07	0.9	23
		N3H		-0.81	7.86	2,5	7.78	7.86	7.86	0.10	1.2	26
P <sub>PO4</sub>	µg/l	A1P		-1.63	11.3	10	10.4	11.3	11.0	0.9	8.6	18
	µg/l	B2P		0.05	25.4	15	25.5	25.5	25.5	1.8	7.2	16
	µg/l	N3P		-1.31	20.0	15	18.0	20.7	20.0	1.5	7.5	17

# Appendix 8 (6/16)

Participant 9												
Measurand	Unit	Sample	-3 0 3	z score	Assigned value	2*s <sub>pt</sub> %	Participant's result	Md	Mean	s	s %	n <sub>stat</sub>
P <sub>tot</sub>	µg/l	A1P		-1.55	25.0	15	22.1	25.1	25.2	1.7	6.7	21
	µg/l	B2P		-1.35	32.2	15	29.0	31.6	32.3	2.4	7.5	18
	µg/l	N3P		-0.87	43.6	10	41.7	43.2	43.6	2.3	5.2	21
Turbidity	FNU	A1S		0.52	3.07	15	3.19	3.08	3.05	0.14	4.6	23
	FNU	B2S		-0.25	0.19	30	0.18	0.19	0.19	0.04	19.0	15
	FNU	N3S		-0.04	3.39	15	3.38	3.40	3.39	0.19	5.5	23

Participant 10												
Measurand	Unit	Sample	-3 0 3	z score	Assigned value	2*s <sub>pt</sub> %	Participant's result	Md	Mean	s	s %	n <sub>stat</sub>
Conductivity 25	mS/m	A1J		0.99	9.31	5	9.54	9.33	9.33	0.20	2.1	24
	mS/m	B2H		-1.24	1000	5	969	1005	1000	17	1.7	19
	mS/m	N3H		0.66	11.5	5	11.7	11.5	11.5	0.2	2.0	23
N <sub>tot</sub>	µg/l	A1N		3.85	170	20	236	170	172	15	8.7	16
	µg/l	B2N		1.71	508	15	573	513	507	36	7.1	15
	µg/l	N3N		0.53	777	10	798	780	778	33	4.3	18
pH		A1H		1.93	7.28	2,7	7.47	7.29	7.29	0.02	0.3	30
		B2H		1.12	8.21	2,4	8.32	8.21	8.21	0.07	0.9	23
		N3H		1.63	7.86	2,5	8.02	7.86	7.86	0.10	1.2	26
P <sub>tot</sub>	µg/l	A1P		0.53	25.0	15	26.0	25.1	25.2	1.7	6.7	21
	µg/l	B2P		-0.29	32.2	15	31.5	31.6	32.3	2.4	7.5	18
	µg/l	N3P		0.64	43.6	10	45.0	43.2	43.6	2.3	5.2	21

Participant 11												
Measurand	Unit	Sample	-3 0 3	z score	Assigned value	2*s <sub>pt</sub> %	Participant's result	Md	Mean	s	s %	n <sub>stat</sub>
Conductivity 25	mS/m	A1J		-0.95	9.31	5	9.09	9.33	9.33	0.20	2.1	24
	mS/m	B2H		-0.80	1000	5	980	1005	1000	17	1.7	19
	mS/m	N3H		-1.39	11.5	5	11.1	11.5	11.5	0.2	2.0	23
pH		A1H		0.20	7.28	2,7	7.30	7.29	7.29	0.02	0.3	30
		B2H		1.12	8.21	2,4	8.32	8.21	8.21	0.07	0.9	23
		N3H		0.31	7.86	2,5	7.89	7.86	7.86	0.10	1.2	26
Turbidity	FNU	A1S		5.34	3.07	15	4.30	3.08	3.05	0.14	4.6	23
	FNU	B2S		35.44	0.19	30	1.20	0.19	0.19	0.04	19.0	15
	FNU	N3S		-0.35	3.39	15	3.30	3.40	3.39	0.19	5.5	23

Participant 12												
Measurand	Unit	Sample	-3 0 3	z score	Assigned value	2*s <sub>pt</sub> %	Participant's result	Md	Mean	s	s %	n <sub>stat</sub>
Chlorophyll a	abs/cm	A1K		0.90	0.16	10	0.17	0.16	0.16	0.00	2.2	13
	µg/l	B2K		0.00	11.7	15	11.7	11.6	11.7	0.3	2.7	13
	µg/l	N3K		-0.39	24.0	15	23.3	24.3	24.0	1.4	5.9	14
Colour <sub>Visual</sub>	mg/l, Pt	A1V		-5.33	25	15	15	25	24	2	8.4	11
	mg/l, Pt	B2S		17.14	10	35	40	10	9	1	13.1	7
	mg/l, Pt	N3S		-3.24	37	20	25	38	37	3	9.4	10
Conductivity 25	mS/m	A1J		4312.31	9.31	5	1013.00	9.33	9.33	0.20	2.1	24
	mS/m	B2H		-39.52	1000	5	12	1005	1000	17	1.7	19
	mS/m	N3H		-6.47	11.5	5	9.6	11.5	11.5	0.2	2.0	23
N <sub>NH4</sub>	µg/l	A1N		-2.63	15	20	11.1	15.5	15.6	1.9	12.3	20
	µg/l	B2N		0.76	39.9	20	43.0	39.0	39.6	3.6	9.2	17
	µg/l	N3N		0.40	65.5	15	67.5	65.0	65.4	3.8	5.9	21

Participant 12												
Measurand	Unit	Sample	-3 0 3	z score	Assigned value	2×s <sub>pt</sub> %	Participant's result	Md	Mean	s	s %	n <sub>stat</sub>
N <sub>NO2+NO3</sub>	µg/l	A1N		1.98	126	8	136	130	130	5	3.5	18
	µg/l	B2N		-0.15	218	15	216	215	219	21	9.5	16
	µg/l	N3N		0.62	355	10	366	361	355	17	4.8	18
N <sub>tot</sub>	µg/l	A1N		0.59	170	20	180	170	172	15	8.7	16
	µg/l	B2N		-0.59	508	15	486	513	507	36	7.1	15
	µg/l	N3N		-1.13	777	10	733	780	778	33	4.3	18
pH		A1H		0.51	7.28	2,7	7.33	7.29	7.29	0.02	0.3	30
		B2H		1.02	8.21	2,4	8.31	8.21	8.21	0.07	0.9	23
		N3H		0.81	7.86	2,5	7.94	7.86	7.86	0.10	1.2	26
P <sub>PO4</sub>	µg/l	A1P		-3.19	11.3	10	9.5	11.3	11.0	0.9	8.6	18
	µg/l	B2P		-1.23	25.4	15	23.1	25.5	25.5	1.8	7.2	16
	µg/l	N3P		-1.40	20.0	15	17.9	20.7	20.0	1.5	7.5	17
P <sub>tot</sub>	µg/l	A1P		3.39	25.0	15	31.4	25.1	25.2	1.7	6.7	21
	µg/l	B2P		0.23	32.2	15	32.8	31.6	32.3	2.4	7.5	18
	µg/l	N3P		1.06	43.6	10	45.9	43.2	43.6	2.3	5.2	21
Turbidity	FNU	A1S		-0.83	3.07	15	2.88	3.08	3.05	0.14	4.6	23
	FNU	B2S		-0.49	0.19	30	0.18	0.19	0.19	0.04	19.0	15
	FNU	N3S		-0.51	3.39	15	3.26	3.40	3.39	0.19	5.5	23

Participant 13												
Measurand	Unit	Sample	-3 0 3	z score	Assigned value	2×s <sub>pt</sub> %	Participant's result	Md	Mean	s	s %	n <sub>stat</sub>
Conductivity 25	mS/m	A1J		0.00	9.31	5	9.31	9.33	9.33	0.20	2.1	24
	mS/m	B2H		-2.68	1000	5	933	1005	1000	17	1.7	19
	mS/m	N3H		0.03	11.5	5	11.5	11.5	11.5	0.2	2.0	23
pH		A1H		0.41	7.28	2,7	7.32	7.29	7.29	0.02	0.3	30
		B2H		0.30	8.21	2,4	8.24	8.21	8.21	0.07	0.9	23
		N3H		0.10	7.86	2,5	7.87	7.86	7.86	0.10	1.2	26

Participant 14												
Measurand	Unit	Sample	-3 0 3	z score	Assigned value	2×s <sub>pt</sub> %	Participant's result	Md	Mean	s	s %	n <sub>stat</sub>
Chlorophyll a	abs/cm	A1K		-0.75	0.16	10	0.15	0.16	0.16	0.00	2.2	13
	µg/l	B2K		-3.00	11.7	15	9.1	11.6	11.7	0.3	2.7	13
	µg/l	N3K		-0.61	24.0	15	22.9	24.3	24.0	1.4	5.9	14
Colour <sub>Spectrophotometric</sub>	mg/l, Pt	A1V		0.18	22.3	15	22.6	22.5	22.4	1.3	6.0	14
	mg/l, Pt	B2S		0.21	8.83	35	9.2	8.8	9.0	1.4	16.1	10
	mg/l, Pt	N3S		-1.18	36.5	25	31.1	36.1	36.9	5.2	14.0	12
Conductivity 25	mS/m	A1J		0.99	9.31	5	9.54	9.33	9.33	0.20	2.1	24
	mS/m	B2H		0.96	1000	5	1024	1005	1000	17	1.7	19
	mS/m	N3H		0.70	11.5	5	11.7	11.5	11.5	0.2	2.0	23
N <sub>NH4</sub>	µg/l	A1N		1.03	15	20	16.6	15.5	15.6	1.9	12.3	20
	µg/l	B2N		-0.19	39.9	20	39.2	39.0	39.6	3.6	9.2	17
	µg/l	N3N		0.00	65.5	15	65.5	65.0	65.4	3.8	5.9	21
N <sub>NO2+NO3</sub>	µg/l	A1N		7.14	126	8	162	130	130	5	3.5	18
	µg/l	B2N		3.06	218	15	268	215	219	21	9.5	16
	µg/l	N3N		4.37	355	10	433	361	355	17	4.8	18
N <sub>tot</sub>	µg/l	A1N		1.82	170	20	201	170	172	15	8.7	16
	µg/l	B2N		1.04	508	15	548	513	507	36	7.1	15
	µg/l	N3N		1.29	777	10	827	780	778	33	4.3	18

## Appendix 8 (8/16)

Participant 14													
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Participant 17														
Measurand	Unit	Sample	<div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div></div>	z score	Assigned value	2×s <sub>pt</sub> %	Participant's result	Md	Mean	s	s %	n <sub>stat</sub>		
Colour <sub>Spectrophotometric</sub>	mg/l, Pt	A1V	<div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div></div>	-0.12	22.3	15	22.1	22.5	22.4	1.3	6.0	14		
	mg/l, Pt	N3S	<div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div></div>	-0.72	36.5	25	33.2	36.1	36.9	5.2	14.0	12		
Conductivity 25	mS/m	A1J	<div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div></div>	0.09	9.31	5	9.33	9.33	9.33	0.20	2.1	24		
	mS/m	N3H	<div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div></div>	0.31	11.5	5	11.6	11.5	11.5	0.2	2.0	23		
N <sub>NH4</sub>	µg/l	A1N	<div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div></div>		15	20	14,8	15.5	15.6	1.9	12.3	20		
	µg/l	N3N	<div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div></div>		65.5	15	69,2	65.0	65.4	3.8	5.9	21		
pH		A1H	<div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div></div>	0.31	7.28	2,7	7.31	7.29	7.29	0.02	0.3	30		
		N3H	<div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div></div>	0.71	7.86	2,5	7.93	7.86	7.86	0.10	1.2	26		
Turbidity	FNU	A1S	<div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div></div>	-0.43	3.07	15	2.97	3.08	3.05	0.14	4.6	23		
	FNU	N3S	<div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div></div>	-1.02	3.39	15	3.13	3.40	3.39	0.19	5.5	23		

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# Appendix 8 (10/16)

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Colour <sub>Visual</sub>	mg/l, Pt	A1V	<div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div>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Participant 22														
Measurand	Unit	Sample	<div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div></div> <div>-303</div>	z score	Assigned value	2×s <sub>pt</sub> %	Participant's result	Md	Mean	s	s %	n <sub>stat</sub>		
Colour <sub>Spectrophotometric</sub>	mg/l, Pt	A1V	<div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div></div>	-0.06	22.3	15	22.2	22.5	22.4	1.3	6.0	14		
	mg/l, Pt	N3S	<div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div></div>	-0.02	36.5	25	36.4	36.1	36.9	5.2	14.0	12		
Conductivity 25	mS/m	A1J	<div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div></div>	0.64	9.31	5	9.46	9.33	9.33	0.20	2.1	24		
	mS/m	N3H	<div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div></div>	1.08	11.5	5	11.8	11.5	11.5	0.2	2.0	23		
N <sub>NH4</sub>	µg/l	A1N	<div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div></div>		15	20	15	15.5	15.6	1.9	12.3	20		
	µg/l	N3N	<div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div></div>		65.5	15	69	65.0	65.4	3.8	5.9	21		
N <sub>NO2+NO3</sub>	µg/l	A1N	<div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div></div>		126	8	<230	130	130	5	3.5	18		
	µg/l	N3N	<div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div></div>		355	10	583	361	355	17	4.8	18		
N <sub>tot</sub>	µg/l	A1N	<div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div></div>		170	20	<1000	170	172	15	8.7	16		
	µg/l	N3N	<div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div></div>		777	10	<1000	780	778	33	4.3	18		
pH		A1H	<div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div></div>	0.00	7.28	2,7	7.28	7.29	7.29	0.02	0.3	30		
		N3H	<div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div></div>	-0.61	7.86	2,5	7.80	7.86	7.86	0.10	1.2	26		
P <sub>PO4</sub>	µg/l	A1P	<div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div></div>		11.3	10	<50	11.3	11.0	0.9	8.6	18		
	µg/l	N3P	<div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div></div>		20.0	15	<50	20.7	20.0	1.5	7.5	17		
P <sub>tot</sub>	µg/l	A1P	<div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div></div>		25.0	15	<50	25.1	25.2	1.7	6.7	21		
	µg/l	N3P	<div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div></div>		43.6	10	<50	43.2	43.6	2.3	5.2	21		
Turbidity	FNU	A1S	<div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div></div>	-0.26	3.07	15	3.01	3.08	3.05	0.14	4.6	23		
	FNU	N3S	<div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div></div>	-0.20	3.39	15	3.34	3.40	3.39	0.19	5.5	23		

Participant 23												
Measurand	Unit	Sample	-3 0 3	z score	Assigned value	2*s <sub>pt</sub> %	Participant's result	Md	Mean	s	s %	n <sub>stat</sub>
Chlorophyll <i>a</i>	abs/cm	A1K		-0.13	0.16	10	0.16	0.16	0.16	0.00	2.2	13
	µg/l	B2K		0.23	11.7	15	11.9	11.6	11.7	0.3	2.7	13
	µg/l	N3K		0.61	24.0	15	25.1	24.3	24.0	1.4	5.9	14
Colour <sub>Spectrophotometric</sub>	mg/l, Pt	A1V		1.26	22.3	15	24.4	22.5	22.4	1.3	6.0	14
	mg/l, Pt	B2S		0.30	8.83	35	9.3	8.8	9.0	1.4	16.1	10
	mg/l, Pt	N3S		0.57	36.5	25	39.1	36.1	36.9	5.2	14.0	12
Conductivity 25	mS/m	A1J		0.17	9.31	5	9.35	9.33	9.33	0.20	2.1	24
	mS/m	B2H		0.24	1000	5	1006	1005	1000	17	1.7	19
	mS/m	N3H		0.45	11.5	5	11.6	11.5	11.5	0.2	2.0	23
N <sub>NH4</sub>	µg/l	A1N		-0.13	15	20	14.8	15.5	15.6	1.9	12.3	20
	µg/l	B2N		-0.45	39.9	20	38.1	39.0	39.6	3.6	9.2	17
	µg/l	N3N		-0.65	65.5	15	62.3	65.0	65.4	3.8	5.9	21
N <sub>NO2+NO3</sub>	µg/l	A1N		-0.50	126	8	124	130	130	5	3.5	18
	µg/l	B2N		-1.28	218	15	197	215	219	21	9.5	16
	µg/l	N3N		-1.30	355	10	332	361	355	17	4.8	18
N <sub>tot</sub>	µg/l	A1N		-0.52	170	20	161	170	172	15	8.7	16
	µg/l	B2N		-0.02	508	15	507	513	507	36	7.1	15
	µg/l	N3N		-0.45	777	10	760	780	778	33	4.3	18
pH		A1H		-0.41	7.28	2,7	7.24	7.29	7.29	0.02	0.3	30
		B2H		-1.83	8.21	2,4	8.03	8.21	8.21	0.07	0.9	23
		N3H		-2.75	7.86	2,5	7.59	7.86	7.86	0.10	1.2	26
P <sub>PO4</sub>	µg/l	A1P		-0.80	11.3	10	10.9	11.3	11.0	0.9	8.6	18
	µg/l	B2P		-0.05	25.4	15	25.3	25.5	25.5	1.8	7.2	16
	µg/l	N3P		-0.63	20.0	15	19.1	20.7	20.0	1.5	7.5	17
P <sub>tot</sub>	µg/l	A1P		-0.72	25.0	15	23.7	25.1	25.2	1.7	6.7	21
	µg/l	B2P		-0.33	32.2	15	31.4	31.6	32.3	2.4	7.5	18
	µg/l	N3P		-0.30	43.6	10	43.0	43.2	43.6	2.3	5.2	21
Turbidity	FNU	A1S		0.96	3.07	15	3.29	3.08	3.05	0.14	4.6	23
	FNU	B2S		0.04	0.19	30	0.19	0.19	0.19	0.04	19.0	15
	FNU	N3S		0.16	3.39	15	3.43	3.40	3.39	0.19	5.5	23

Participant 24												
Measurand	Unit	Sample	-3 0 3	z score	Assigned value	2*s <sub>pt</sub> %	Participant's result	Md	Mean	s	s %	n <sub>stat</sub>
Colour <sub>Spectrophotometric</sub>	mg/l, Pt	A1V		-0.66	22.3	15	21.2	22.5	22.4	1.3	6.0	14
	mg/l, Pt	N3S		-0.18	36.5	25	35.7	36.1	36.9	5.2	14.0	12
N <sub>NH4</sub>	µg/l	A1N		-1.83	15	20	12.3	15.5	15.6	1.9	12.3	20
	µg/l	N3N		-0.28	65.5	15	64.1	65.0	65.4	3.8	5.9	21
N <sub>NO2+NO3</sub>	µg/l	A1N		1.49	126	8	134	130	130	5	3.5	18
	µg/l	N3N		-0.68	355	10	343	361	355	17	4.8	18
Turbidity	FNU	A1S		-0.22	3.07	15	3.02	3.08	3.05	0.14	4.6	23
	FNU	N3S		-0.55	3.39	15	3.25	3.40	3.39	0.19	5.5	23

## Appendix 8 (12/16)

Participant 25												
Measurand	Unit	Sample	-3 0 3	z score	Assigned value	2×s <sub>pt</sub> %	Participant's result	Md	Mean	s	s %	n <sub>stat</sub>
Chlorophyll a	abs/cm	A1K		41855.00	0.16	10	335.00	0.16	0.16	0.00	2.2	13
	µg/l	B2K		0.82	11.7	15	12.4	11.6	11.7	0.3	2.7	13
	µg/l	N3K		0.61	24.0	15	25.1	24.3	24.0	1.4	5.9	14
Colour <sub>Spectrophotometric</sub>	mg/l, Pt	A1V		-0.94	22.3	15	20.7	22.5	22.4	1.3	6.0	14
	mg/l, Pt	B2S		-0.61	8.83	35	7.9	8.8	9.0	1.4	16.1	10
	mg/l, Pt	N3S		-0.47	36.5	25	34.3	36.1	36.9	5.2	14.0	12
Conductivity 25	mS/m	A1J		-1.25	9.31	5	9.02	9.33	9.33	0.20	2.1	24
	mS/m	B2H		0.48	1000	5	1012	1005	1000	17	1.7	19
	mS/m	N3H		-1.18	11.5	5	11.2	11.5	11.5	0.2	2.0	23
N <sub>NH4</sub>	µg/l	A1N		0.54	15	20	15.8	15.5	15.6	1.9	12.3	20
	µg/l	B2N		-0.61	39.9	20	37.5	39.0	39.6	3.6	9.2	17
	µg/l	N3N		-0.09	65.5	15	65.1	65.0	65.4	3.8	5.9	21
N <sub>NO2+NO3</sub>	µg/l	A1N		-0.35	126	8	124	130	130	5	3.5	18
	µg/l	B2N		-0.74	218	15	206	215	219	21	9.5	16
	µg/l	N3N		-0.89	355	10	339	361	355	17	4.8	18
N <sub>tot</sub>	µg/l	A1N		-0.25	170	20	166	170	172	15	8.7	16
	µg/l	B2N		-2.04	508	15	430	513	507	36	7.1	15
	µg/l	N3N		-0.78	777	10	747	780	778	33	4.3	18
pH		A1H		0.20	7.28	2,7	7.30	7.29	7.29	0.02	0.3	30
		B2H		0.30	8.21	2,4	8.24	8.21	8.21	0.07	0.9	23
		N3H		-0.20	7.86	2,5	7.84	7.86	7.86	0.10	1.2	26
P <sub>PO4</sub>	µg/l	A1P		0.09	11.3	10	11.4	11.3	11.0	0.9	8.6	18
	µg/l	B2P		-1.67	25.4	15	22.2	25.5	25.5	1.8	7.2	16
	µg/l	N3P		0.91	20.0	15	21.4	20.7	20.0	1.5	7.5	17
P <sub>tot</sub>	µg/l	A1P		1.06	25.0	15	27.0	25.1	25.2	1.7	6.7	21
	µg/l	B2P		-0.41	32.2	15	31.2	31.6	32.3	2.4	7.5	18
	µg/l	N3P		0.30	43.6	10	44.3	43.2	43.6	2.3	5.2	21
Turbidity	FNU	A1S		0.65	3.07	15	3.22	3.08	3.05	0.14	4.6	23
	FNU	B2S		1.82	0.19	30	0.24	0.19	0.19	0.04	19.0	15
	FNU	N3S		1.30	3.39	15	3.72	3.40	3.39	0.19	5.5	23

Participant 26												
Measurand	Unit	Sample	-3 0 3	z score	Assigned value	2×s <sub>pt</sub> %	Participant's result	Md	Mean	s	s %	n <sub>stat</sub>
Chlorophyll a	abs/cm	A1K		0.46	0.16	10	0.16	0.16	0.16	0.00	2.2	13
	µg/l	B2K		-0.11	11.7	15	11.6	11.6	11.7	0.3	2.7	13
	µg/l	N3K		0.22	24.0	15	24.4	24.3	24.0	1.4	5.9	14
Colour <sub>Spectrophotometric</sub>	mg/l, Pt	A1V		0.12	22.3	15	22.5	22.5	22.4	1.3	6.0	14
	mg/l, Pt	N3S		-0.02	36.5	25	36.4	36.1	36.9	5.2	14.0	12
Conductivity 25	mS/m	A1J		0.09	9.31	5	9.33	9.33	9.33	0.20	2.1	24
	mS/m	N3H		-0.35	11.5	5	11.4	11.5	11.5	0.2	2.0	23
N <sub>NH4</sub>	µg/l	A1N		-0.57	15	20	14.2	15.5	15.6	1.9	12.3	20
	µg/l	N3N		-0.93	65.5	15	61.0	65.0	65.4	3.8	5.9	21
N <sub>NO2+NO3</sub>	µg/l	A1N		0.83	126	8	130	130	130	5	3.5	18
	µg/l	N3N		0.50	355	10	364	361	355	17	4.8	18
N <sub>tot</sub>	µg/l	A1N		0.18	170	20	173	170	172	15	8.7	16
	µg/l	N3N		0.24	777	10	787	780	778	33	4.3	18
pH		A1H		0.10	7.28	2,7	7.29	7.29	7.29	0.02	0.3	30
		N3H		-0.61	7.86	2,5	7.80	7.86	7.86	0.10	1.2	26

Participant 26												
Measurand	Unit	Sample	-3 0 3	z score	Assigned value	2*s <sub>pt</sub> %	Participant's result	Md	Mean	s	s %	n <sub>stat</sub>
P <sub>PO4</sub>	µg/l	A1P		1.68	11.3	10	12.3	11.3	11.0	0.9	8.6	18
	µg/l	N3P		0.43	20.0	15	20.7	20.7	20.0	1.5	7.5	17
P <sub>tot</sub>	µg/l	A1P		-0.05	25.0	15	24.9	25.1	25.2	1.7	6.7	21
	µg/l	N3P		-0.85	43.6	10	41.8	43.2	43.6	2.3	5.2	21
Turbidity	FNU	A1S		-0.48	3.07	15	2.96	3.08	3.05	0.14	4.6	23
	FNU	N3S		0.12	3.39	15	3.42	3.40	3.39	0.19	5.5	23

Participant 27												
Measurand	Unit	Sample	-3 0 3	z score	Assigned value	2*s <sub>pt</sub> %	Participant's result	Md	Mean	s	s %	n <sub>stat</sub>
Colour <sub>Spectrophotometric</sub>	mg/l, Pt	A1V		0.42	22.3	15	23.0	22.5	22.4	1.3	6.0	14
	mg/l, Pt	B2S		0.76	8.83	35	10.0	8.8	9.0	1.4	16.1	10
	mg/l, Pt	N3S		2.74	36.5	25	49.0	36.1	36.9	5.2	14.0	12
Conductivity 25	mS/m	A1J		-2.62	9.31	5	8.70	9.33	9.33	0.20	2.1	24
	mS/m	B2H		-1.40	1000	5	965	1005	1000	17	1.7	19
	mS/m	N3H		-5.22	11.5	5	10.0	11.5	11.5	0.2	2.0	23
pH		A1H		0.20	7.28	2,7	7.30	7.29	7.29	0.02	0.3	30
		B2H		0.91	8.21	2,4	8.30	8.21	8.21	0.07	0.9	23
		N3H		1.42	7.86	2,5	8.00	7.86	7.86	0.10	1.2	26
Turbidity	FNU	A1S		-1.17	3.07	15	2.80	3.08	3.05	0.14	4.6	23
	FNU	B2S		-2.11	0.19	30	0.13	0.19	0.19	0.04	19.0	15
	FNU	N3S		-1.53	3.39	15	3.00	3.40	3.39	0.19	5.5	23

Participant 28												
Measurand	Unit	Sample	-3 0 3	z score	Assigned value	2*s <sub>pt</sub> %	Participant's result	Md	Mean	s	s %	n <sub>stat</sub>
Chlorophyll a	abs/cm	A1K		0.13	0.16	10	0.16	0.16	0.16	0.00	2.2	13
	µg/l	B2K		0.23	11.7	15	11.9	11.6	11.7	0.3	2.7	13
	µg/l	N3K		0.44	24.0	15	24.8	24.3	24.0	1.4	5.9	14
Colour <sub>Spectrophotometric</sub>	mg/l, Pt	A1V		0.11	22.3	15	22.5	22.5	22.4	1.3	6.0	14
	mg/l, Pt	B2S		3.29	8.83	35	13.9	8.8	9.0	1.4	16.1	10
	mg/l, Pt	N3S		4.68	36.5	25	57.8	36.1	36.9	5.2	14.0	12
Conductivity 25	mS/m	A1J		0.09	9.31	5	9.33	9.33	9.33	0.20	2.1	24
	mS/m	B2H		0.36	1000	5	1009	1005	1000	17	1.7	19
	mS/m	N3H		0.42	11.5	5	11.6	11.5	11.5	0.2	2.0	23
N <sub>NH4</sub>	µg/l	A1N		-0.10	15	20	14.9	15.5	15.6	1.9	12.3	20
	µg/l	B2N		-1.22	39.9	20	35.1	39.0	39.6	3.6	9.2	17
	µg/l	N3N		-0.03	65.5	15	65.4	65.0	65.4	3.8	5.9	21
N <sub>NO2+NO3</sub>	µg/l	A1N		0.89	126	8	131	130	130	5	3.5	18
	µg/l	B2N		0.52	218	15	226	215	219	21	9.5	16
	µg/l	N3N		0.51	355	10	364	361	355	17	4.8	18
N <sub>tot</sub>	µg/l	A1N		0.76	170	20	183	170	172	15	8.7	16
	µg/l	B2N		0.19	508	15	515	513	507	36	7.1	15
	µg/l	N3N		0.70	777	10	804	780	778	33	4.3	18
pH		A1H		0.10	7.28	2,7	7.29	7.29	7.29	0.02	0.3	30
		B2H		-0.10	8.21	2,4	8.20	8.21	8.21	0.07	0.9	23
		N3H		0.00	7.86	2,5	7.86	7.86	7.86	0.10	1.2	26
P <sub>PO4</sub>	µg/l	A1P		-3.54	11.3	10	9.3	11.3	11.0	0.9	8.6	18
	µg/l	B2P		-0.79	25.4	15	23.9	25.5	25.5	1.8	7.2	16
	µg/l	N3P		-1.00	20.0	15	18.5	20.7	20.0	1.5	7.5	17

# Appendix 8 (14/16)

Participant 28												
Measurand	Unit	Sample	-3 0 3	z score	Assigned value	2×s <sub>pt</sub> %	Participant's result	Md	Mean	s	s %	n <sub>stat</sub>
P <sub>tot</sub>	µg/l	A1P		-1.31	25.0	15	22.6	25.1	25.2	1.7	6.7	21
	µg/l	B2P		-1.35	32.2	15	29.0	31.6	32.3	2.4	7.5	18
	µg/l	N3P		-0.85	43.6	10	41.8	43.2	43.6	2.3	5.2	21
Turbidity	FNU	A1S		0.13	3.07	15	3.10	3.08	3.05	0.14	4.6	23
	FNU	B2S		-1.05	0.19	30	0.16	0.19	0.19	0.04	19.0	15
	FNU	N3S		0.20	3.39	15	3.44	3.40	3.39	0.19	5.5	23

Participant 29												
Measurand	Unit	Sample	-3 0 3	z score	Assigned value	2×s <sub>pt</sub> %	Participant's result	Md	Mean	s	s %	n <sub>stat</sub>
Colour <sub>Spectrophotometric</sub>	mg/l, Pt	B2S		1.41	8.83	35	11.0	8.8	9.0	1.4	16.1	10
pH		B2H		-0.10	8.21	2.4	8.20	8.21	8.21	0.07	0.9	23
Turbidity	FNU	B2S		-2.11	0.19	30	0.13	0.19	0.19	0.04	19.0	15

Participant 30												
Measurand	Unit	Sample	-3 0 3	z score	Assigned value	2×s <sub>pt</sub> %	Participant's result	Md	Mean	s	s %	n <sub>stat</sub>
Chlorophyll a	abs/cm	A1K		-0.25	0.16	10	0.16	0.16	0.16	0.00	2.2	13
	µg/l	B2K		-0.46	11.7	15	11.3	11.6	11.7	0.3	2.7	13
	µg/l	N3K		-0.72	24.0	15	22.7	24.3	24.0	1.4	5.9	14
Colour <sub>Visual</sub>	mg/l, Pt	A1V		0.00	25	15	25	25	24	2	8.4	11
	mg/l, Pt	B2S		2.86	10	35	15	10	9	1	13.1	7
	mg/l, Pt	N3S		0.81	37	20	40	38	37	3	9.4	10
Conductivity 25	mS/m	A1J		0.04	9.31	5	9.32	9.33	9.33	0.20	2.1	24
	mS/m	B2H		0.40	1000	5	1010	1005	1000	17	1.7	19
	mS/m	N3H		-0.52	11.5	5	11.4	11.5	11.5	0.2	2.0	23
N <sub>NH4</sub>	µg/l	A1N		0.70	15	20	16.1	15.5	15.6	1.9	12.3	20
	µg/l	B2N		0.28	39.9	20	41.0	39.0	39.6	3.6	9.2	17
	µg/l	N3N		-1.20	65.5	15	59.6	65.0	65.4	3.8	5.9	21
N <sub>NO2+NO3</sub>	µg/l	A1N		-0.99	126	8	121	130	130	5	3.5	18
	µg/l	B2N		-1.01	218	15	202	215	219	21	9.5	16
	µg/l	N3N		-0.79	355	10	341	361	355	17	4.8	18
N <sub>tot</sub>	µg/l	A1N		-0.50	170	20	162	170	172	15	8.7	16
	µg/l	B2N		-1.35	508	15	457	513	507	36	7.1	15
	µg/l	N3N		-1.16	777	10	732	780	778	33	4.3	18
pH		A1H		0.20	7.28	2.7	7.30	7.29	7.29	0.02	0.3	30
		B2H		0.30	8.21	2.4	8.24	8.21	8.21	0.07	0.9	23
		N3H		0.81	7.86	2.5	7.94	7.86	7.86	0.10	1.2	26
P <sub>PO4</sub>	µg/l	A1P		0.44	11.3	10	11.6	11.3	11.0	0.9	8.6	18
	µg/l	B2P		0.89	25.4	15	27.1	25.5	25.5	1.8	7.2	16
	µg/l	N3P		1.10	20.0	15	21.7	20.7	20.0	1.5	7.5	17
P <sub>tot</sub>	µg/l	A1P		0.40	25.0	15	25.8	25.1	25.2	1.7	6.7	21
	µg/l	B2P		0.43	32.2	15	33.3	31.6	32.3	2.4	7.5	18
	µg/l	N3P		0.78	43.6	10	45.3	43.2	43.6	2.3	5.2	21
Turbidity	FNU	A1S		-0.39	3.07	15	2.98	3.08	3.05	0.14	4.6	23
	FNU	B2S		1.86	0.19	30	0.24	0.19	0.19	0.04	19.0	15
	FNU	N3S		0.28	3.39	15	3.46	3.40	3.39	0.19	5.5	23

Participant 31												
Measurand	Unit	Sample		z score	Assigned value	2×s <sub>pt</sub> %	Participant's result	Md	Mean	s	s %	n <sub>stat</sub>
Colour <sub>Visual</sub>	mg/l, Pt	A1V		-2.67	25	15	20	25	24	2	8.4	11
	mg/l, Pt	N3S		-0.54	37	20	35	38	37	3	9.4	10
Conductivity 25	mS/m	A1J		-0.17	9.31	5	9.27	9.33	9.33	0.20	2.1	24
	mS/m	N3H		-0.07	11.5	5	11.5	11.5	11.5	0.2	2.0	23
N <sub>NH4</sub>	µg/l	A1N		2.07	15	20	18.1	15.5	15.6	1.9	12.3	20
	µg/l	N3N		-0.14	65.5	15	64.8	65.0	65.4	3.8	5.9	21
N <sub>NO2+NO3</sub>	µg/l	A1N		1.29	126	8	133	130	130	5	3.5	18
	µg/l	N3N		0.93	355	10	372	361	355	17	4.8	18
pH		A1H		-0.20	7.28	2,7	7.26	7.29	7.29	0.02	0.3	30
		N3H		-0.10	7.86	2,5	7.85	7.86	7.86	0.10	1.2	26
P <sub>PO4</sub>	µg/l	A1P		0.35	11.3	10	11.5	11.3	11.0	0.9	8.6	18
	µg/l	N3P		1.18	20.0	15	21.8	20.7	20.0	1.5	7.5	17
P <sub>tot</sub>	µg/l	A1P		0.21	25.0	15	25.4	25.1	25.2	1.7	6.7	21
	µg/l	N3P		1.60	43.6	10	47.1	43.2	43.6	2.3	5.2	21
Turbidity	FNU	A1S		0.43	3.07	15	3.17	3.08	3.05	0.14	4.6	23
	FNU	N3S		-0.43	3.39	15	3.28	3.40	3.39	0.19	5.5	23

Participant 32												
Measurand	Unit	Sample		z score	Assigned value	2×s <sub>pt</sub> %	Participant's result	Md	Mean	s	s %	n <sub>stat</sub>
Chlorophyll a	abs/cm	A1K		-0.13	0.16	10	0.16	0.16	0.16	0.00	2.2	13
	µg/l	B2K		-4.00	11.7	15	8.2	11.6	11.7	0.3	2.7	13
	µg/l	N3K		-1.69	24.0	15	21.0	24.3	24.0	1.4	5.9	14
N <sub>NH4</sub>	µg/l	A1N		5.13	15	20	22.7	15.5	15.6	1.9	12.3	20
	µg/l	B2N		2.78	39.9	20	51.0	39.0	39.6	3.6	9.2	17
	µg/l	N3N		3.69	65.5	15	83.7	65.0	65.4	3.8	5.9	21
N <sub>NO2+NO3</sub>	µg/l	A1N		1.71	126	8	135	130	130	5	3.5	18
	µg/l	B2N		0.53	218	15	227	215	219	21	9.5	16
	µg/l	N3N		0.74	355	10	368	361	355	17	4.8	18
N <sub>tot</sub>	µg/l	A1N		0.31	170	20	175	170	172	15	8.7	16
	µg/l	B2N		-0.31	508	15	496	513	507	36	7.1	15
	µg/l	N3N		-0.03	777	10	776	780	778	33	4.3	18
pH		A1H		0.00	7.28	2,7	7.28	7.29	7.29	0.02	0.3	30
P <sub>PO4</sub>	µg/l	A1P		-3.03	11.3	10	9.6	11.3	11.0	0.9	8.6	18
	µg/l	B2P		-0.88	25.4	15	23.7	25.5	25.5	1.8	7.2	16
	µg/l	N3P		-1.45	20.0	15	17.8	20.7	20.0	1.5	7.5	17
P <sub>tot</sub>	µg/l	A1P		-0.43	25.0	15	24.2	25.1	25.2	1.7	6.7	21
	µg/l	B2P		0.32	32.2	15	33.0	31.6	32.3	2.4	7.5	18
	µg/l	N3P		-0.20	43.6	10	43.2	43.2	43.6	2.3	5.2	21

Participant 33												
Measurand	Unit	Sample		z score	Assigned value	2×s <sub>pt</sub> %	Participant's result	Md	Mean	s	s %	n <sub>stat</sub>
Chlorophyll a	abs/cm	A1K		0.31	0.16	10	0.16	0.16	0.16	0.00	2.2	13

## Appendix 8 (16/16)

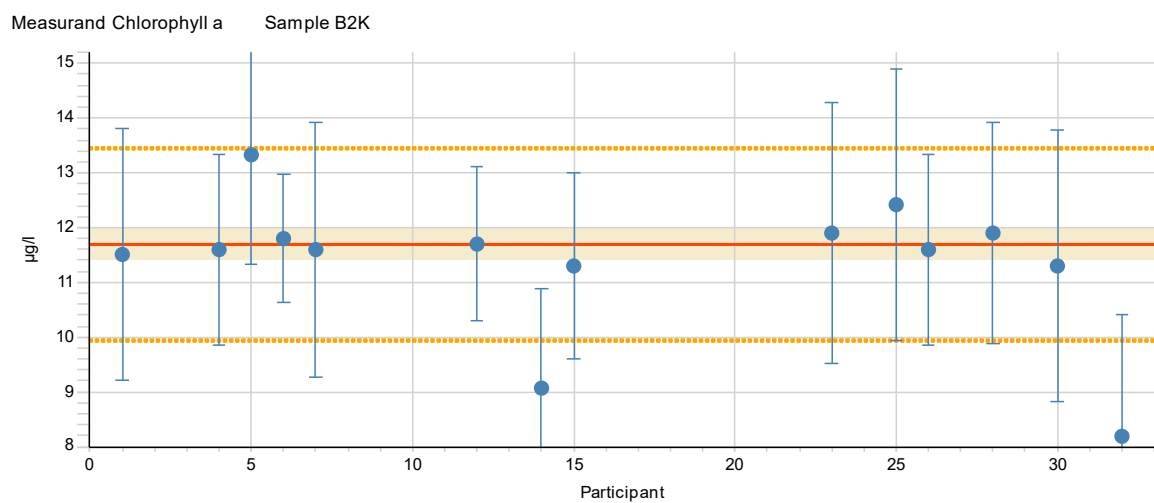
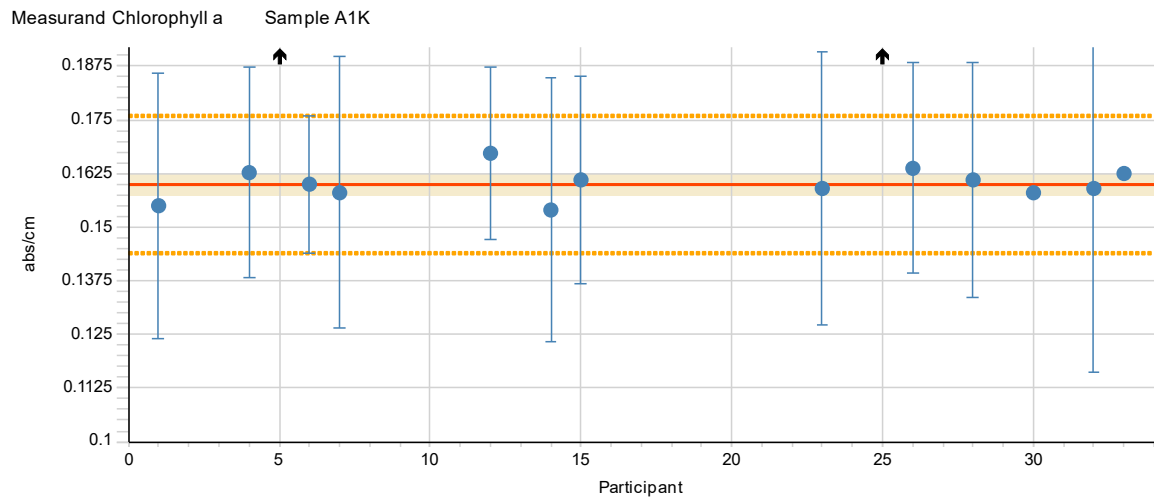
Participant 34												
Measurand	Unit	Sample	<div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><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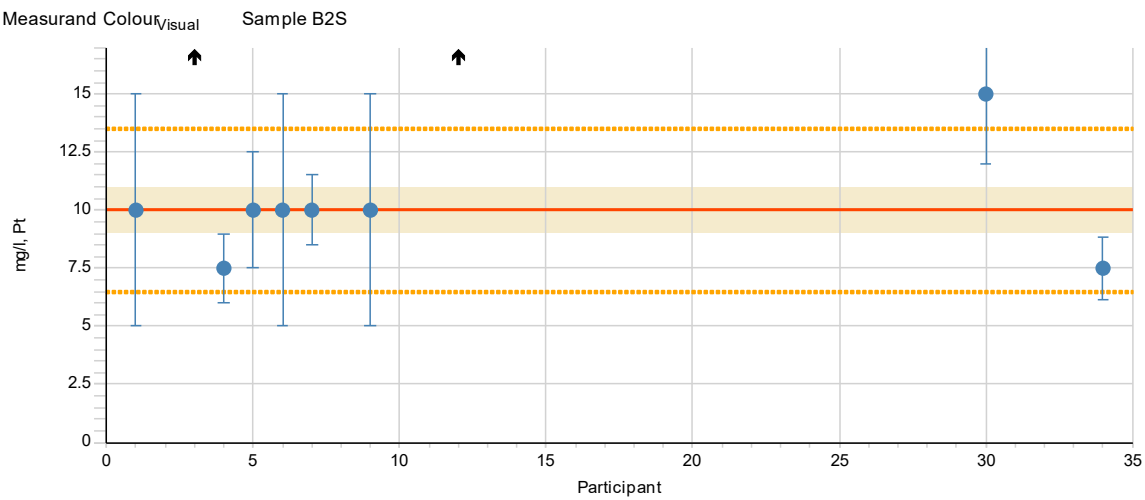
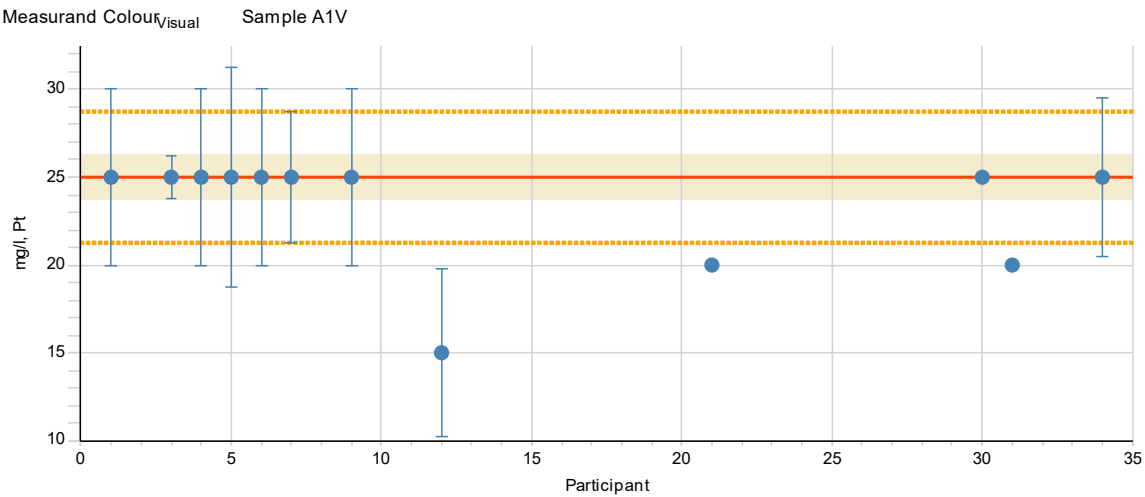
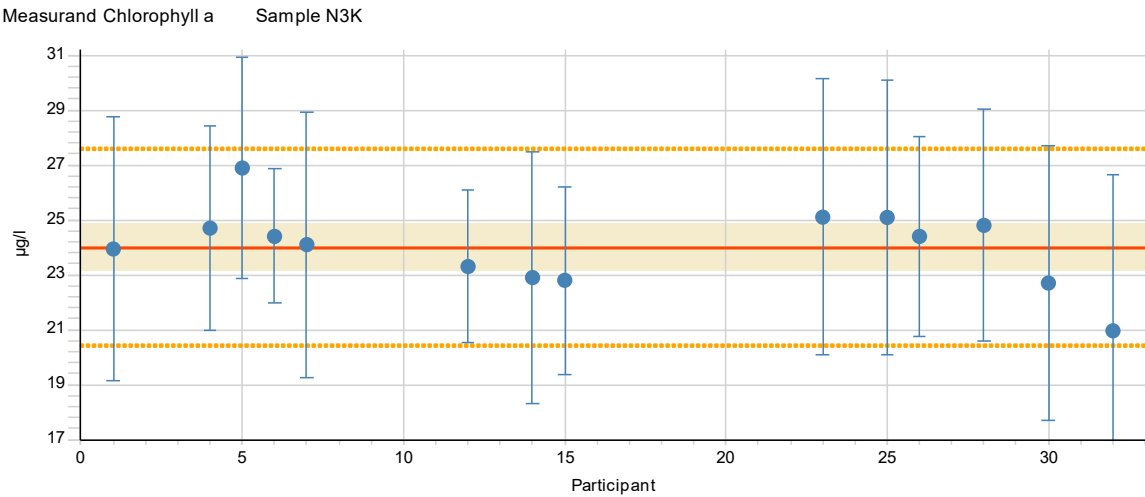


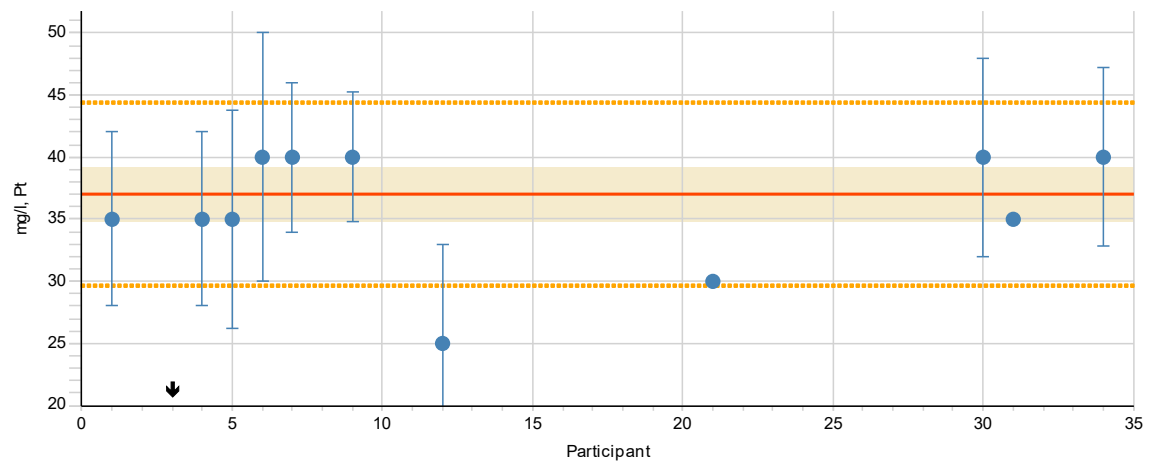
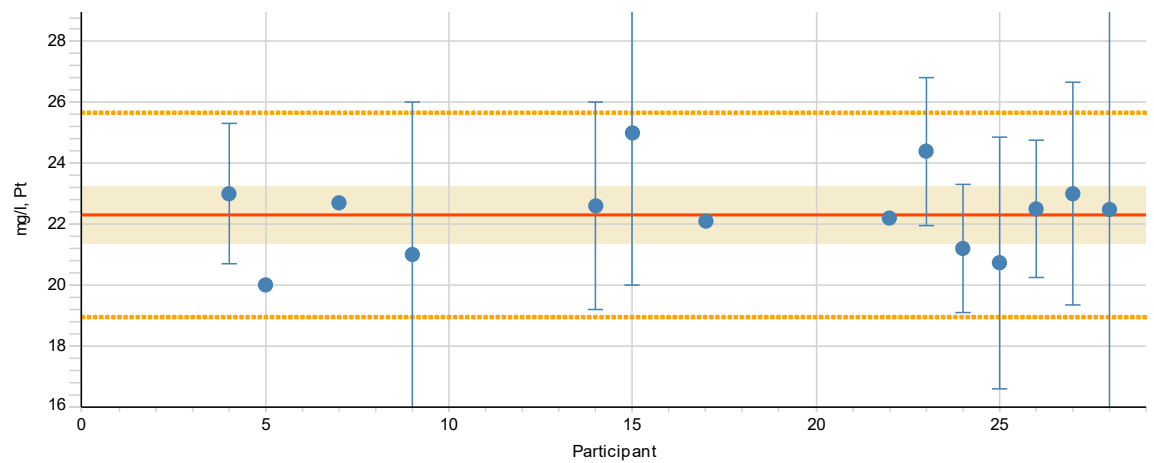
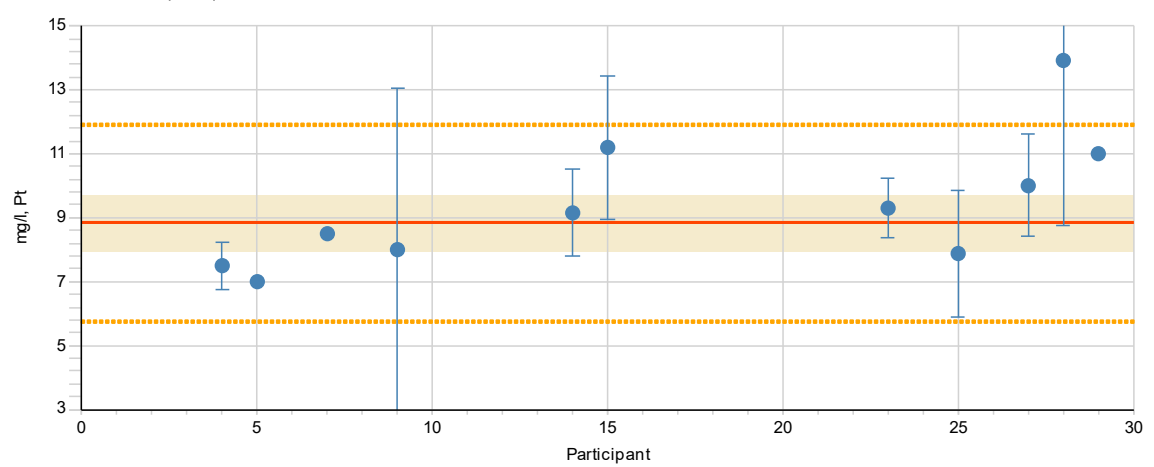
## Appendix 9. Results of participants and their uncertainties

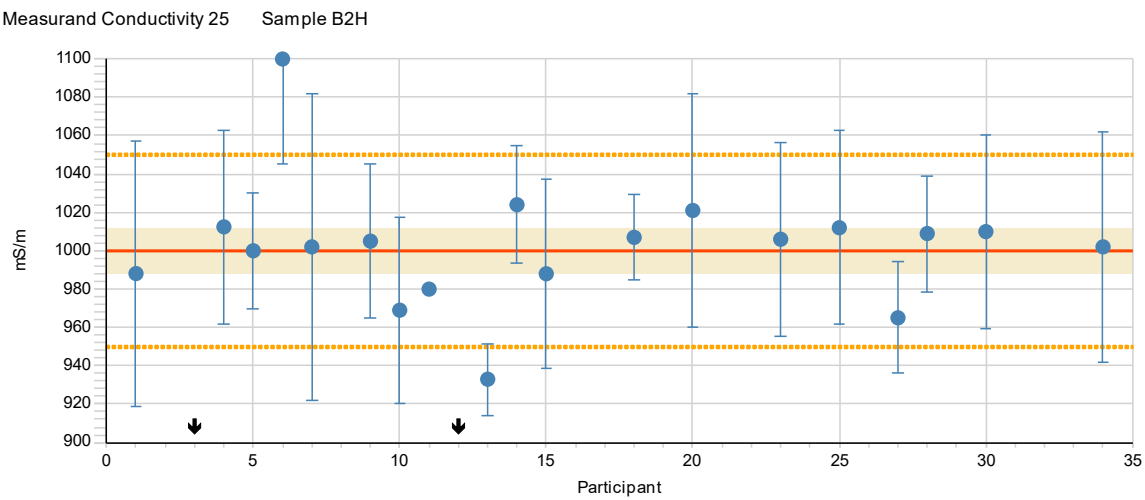
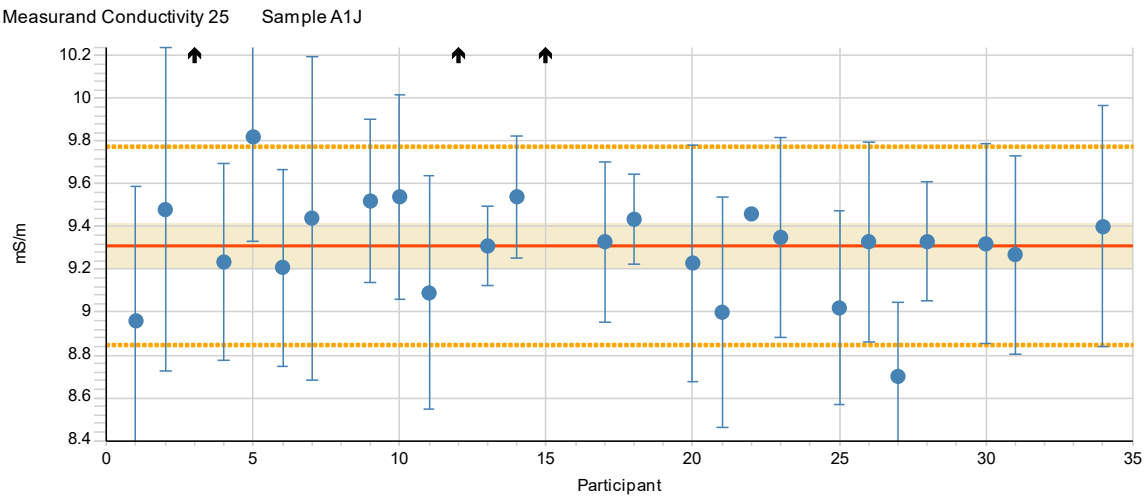
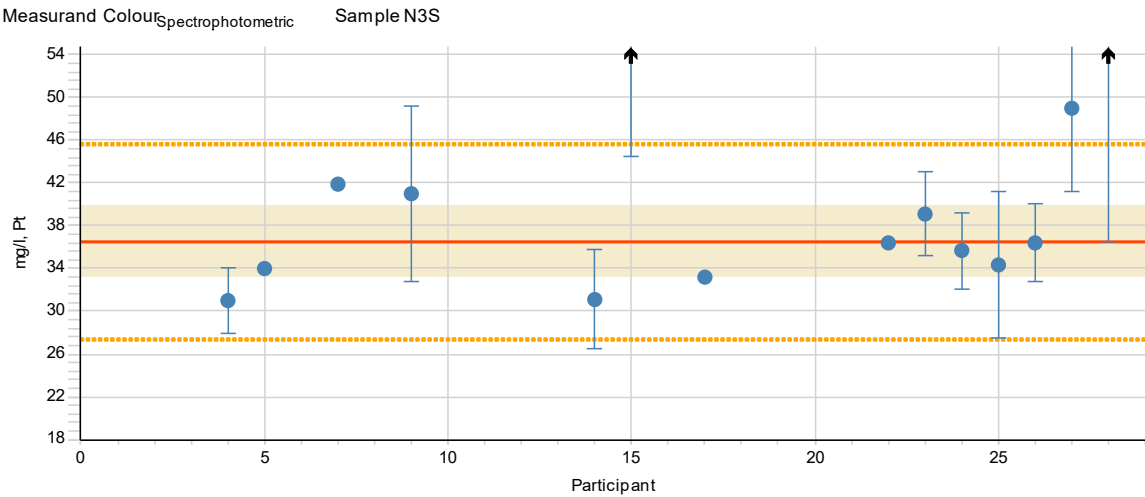
In figures:

- The dashed lines describe the standard deviation for the proficiency assessment, the red solid line shows the assigned value, the shaded area describes the expanded uncertainty of the assigned value, and the arrow describes the value outside the scale.

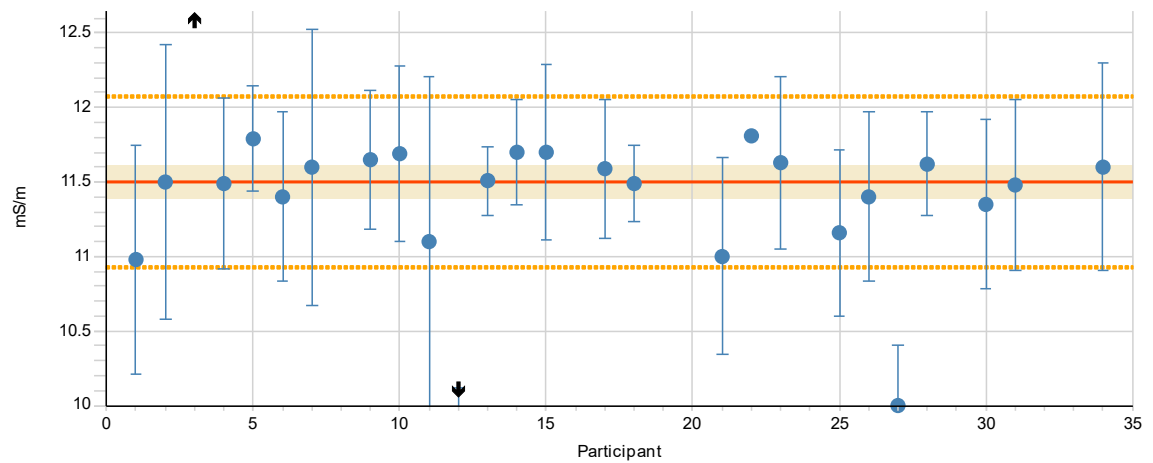
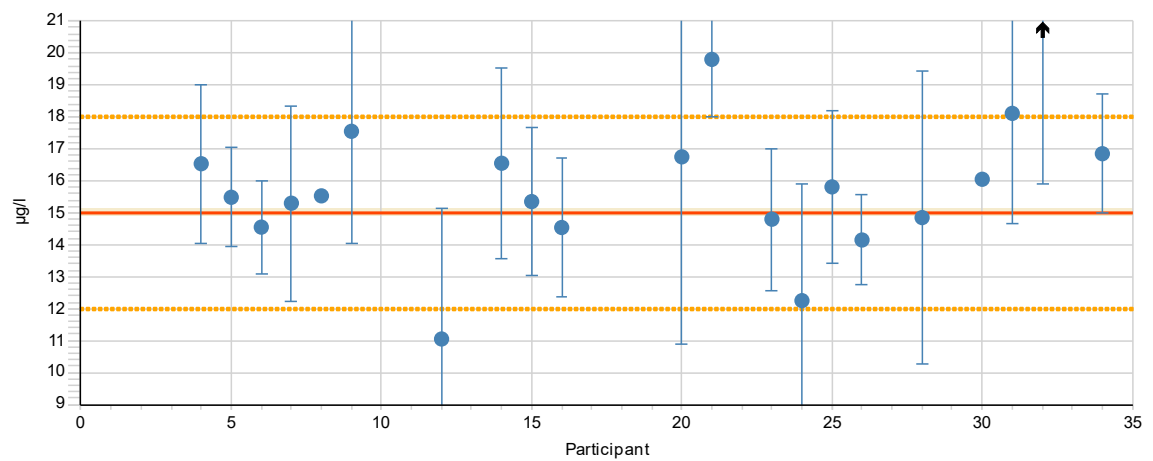
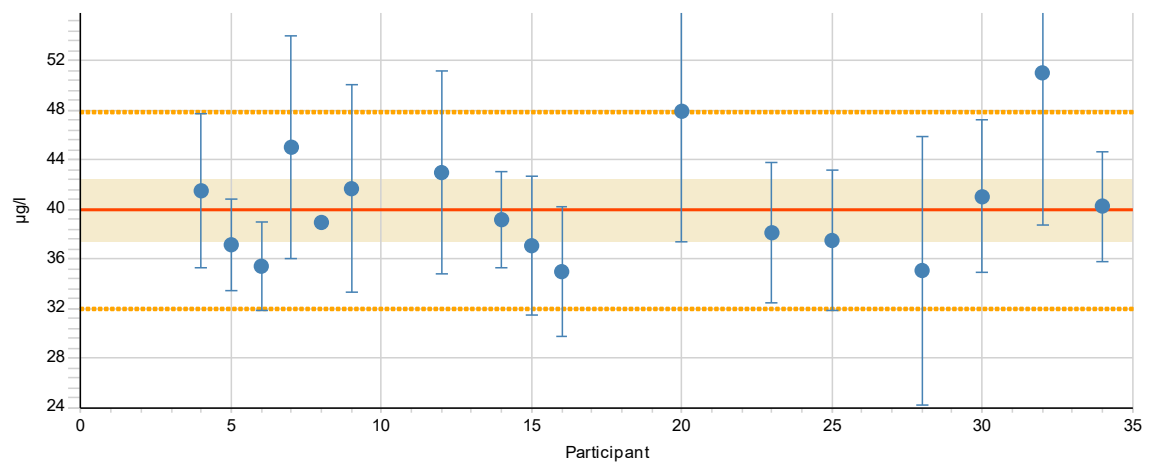


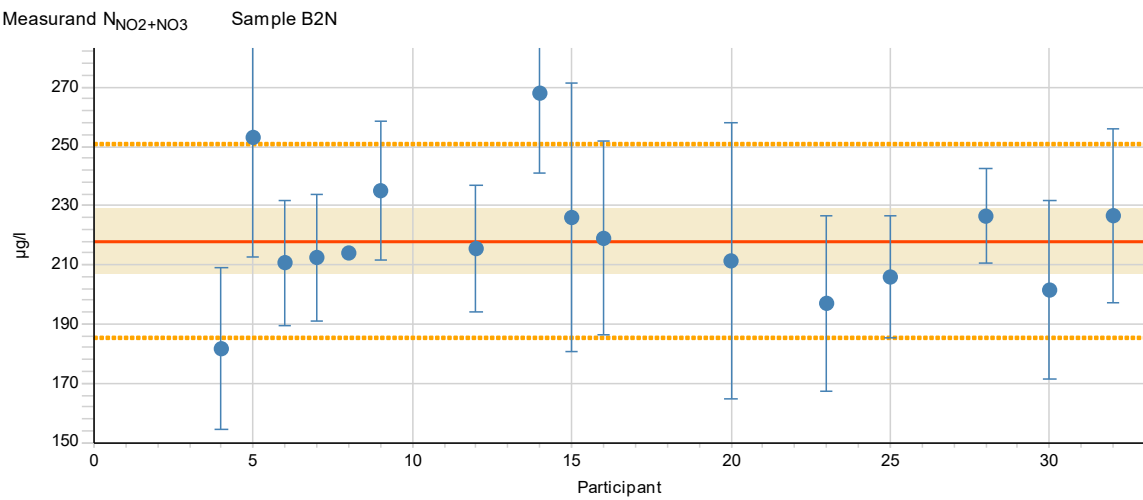
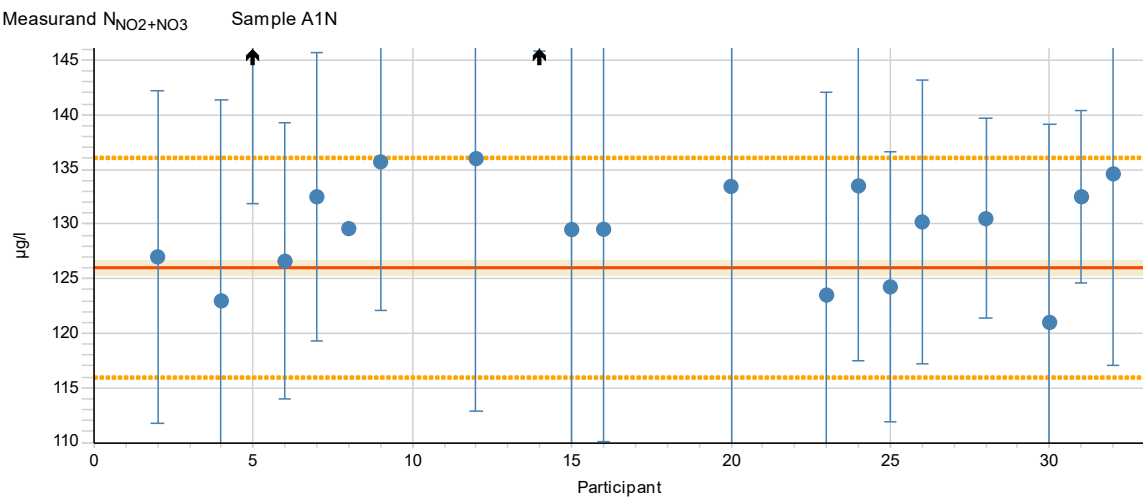
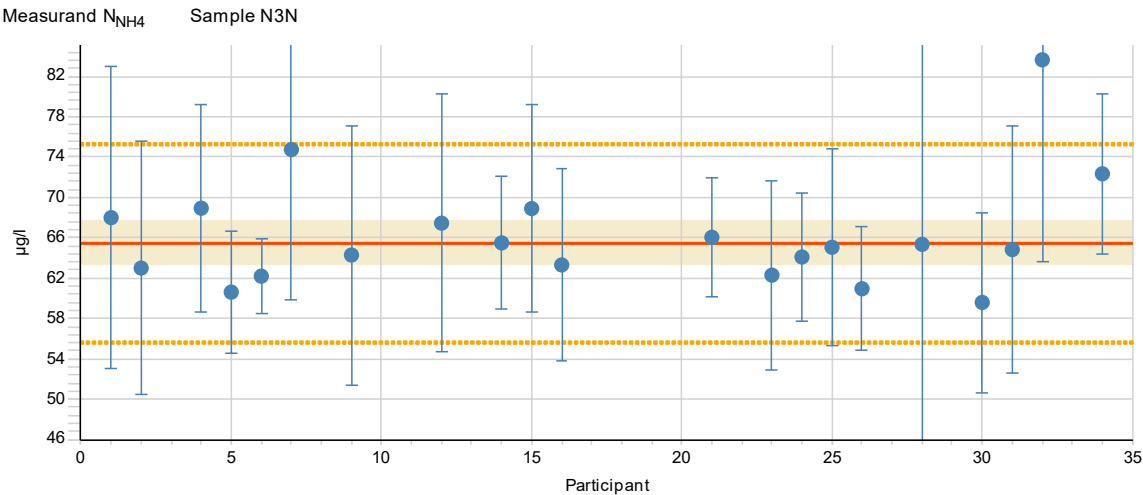


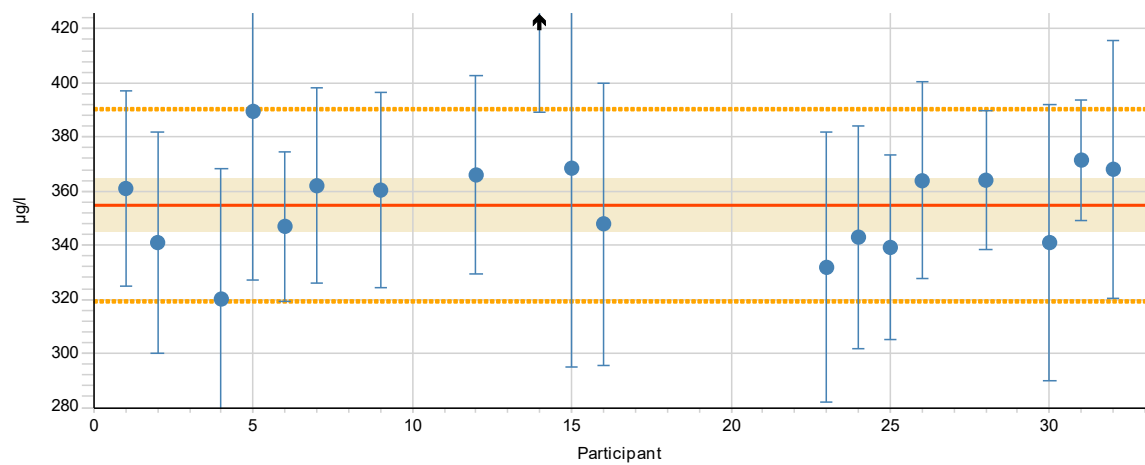
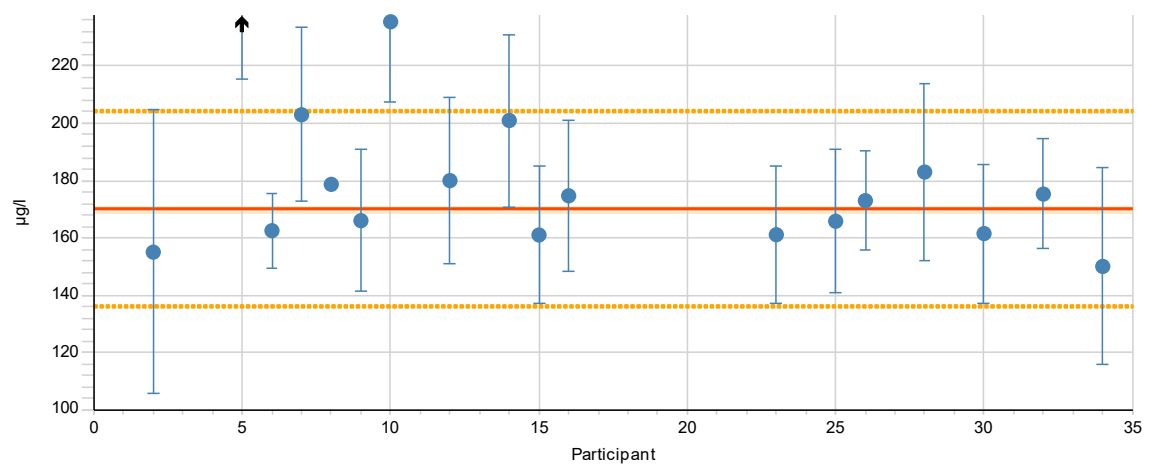
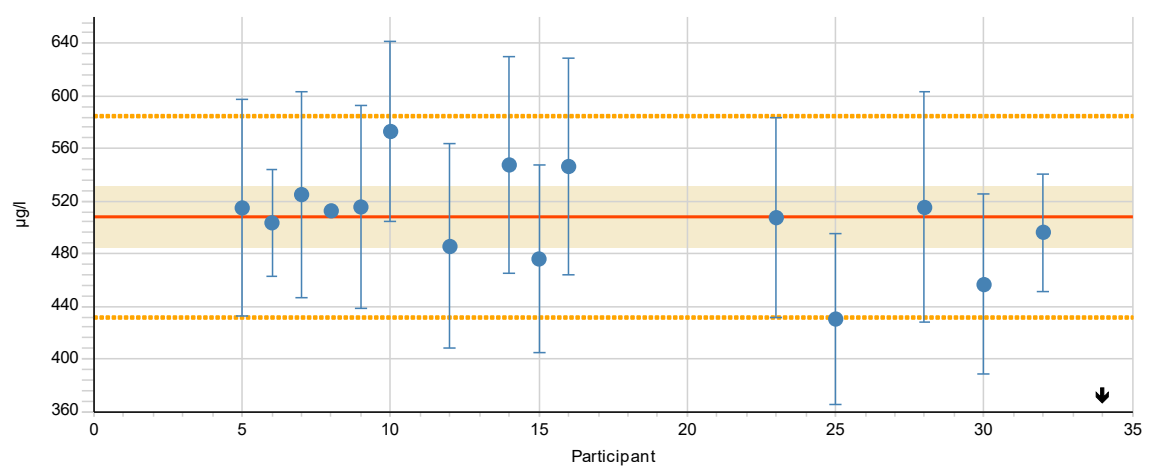
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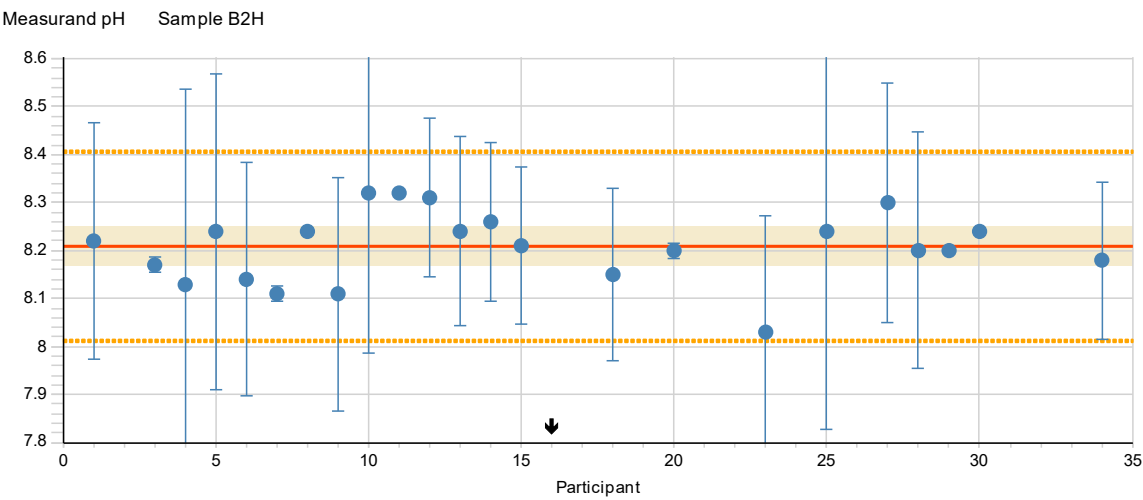
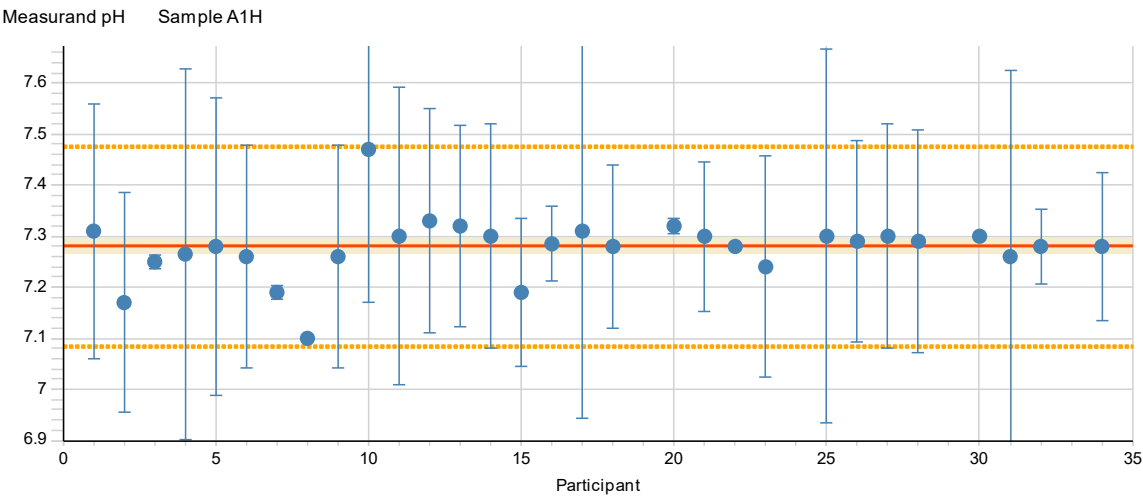
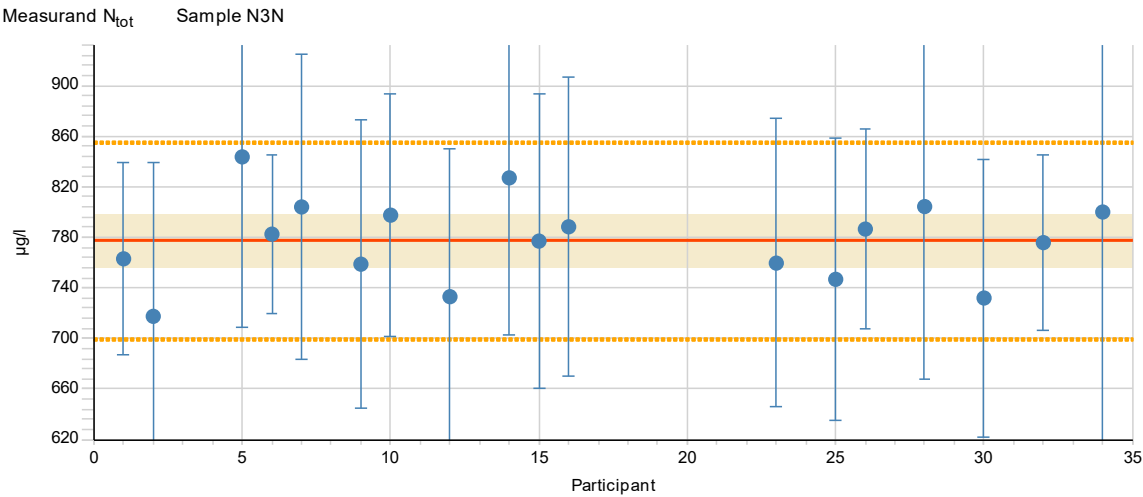


Measurand Conductivity 25 Sample N3H

Measurand  $N_{NH_4}$  Sample A1NMeasurand  $N_{NH_4}$  Sample B2N

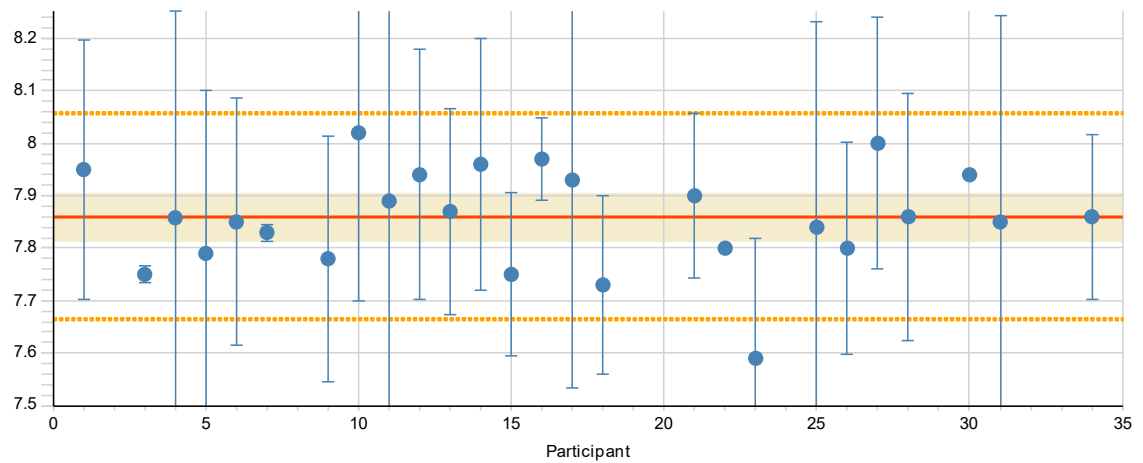
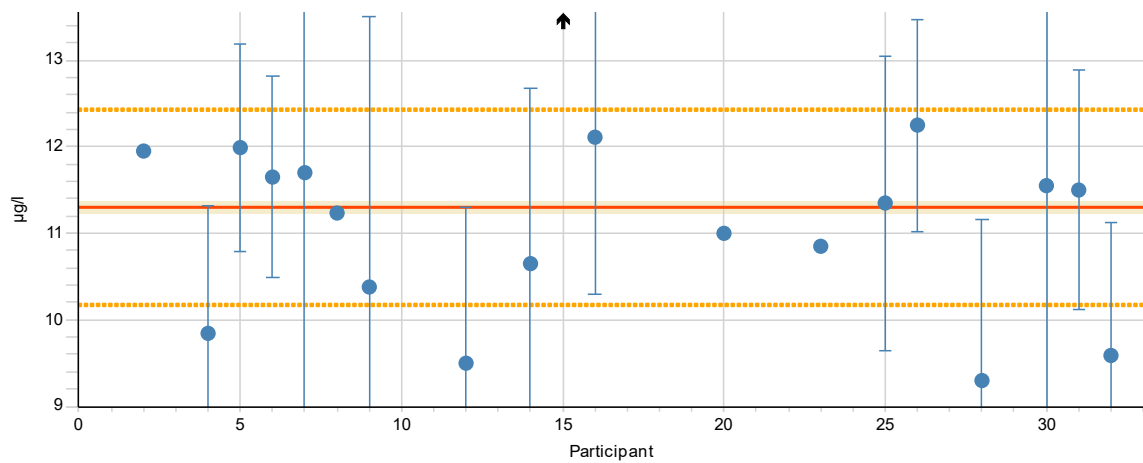
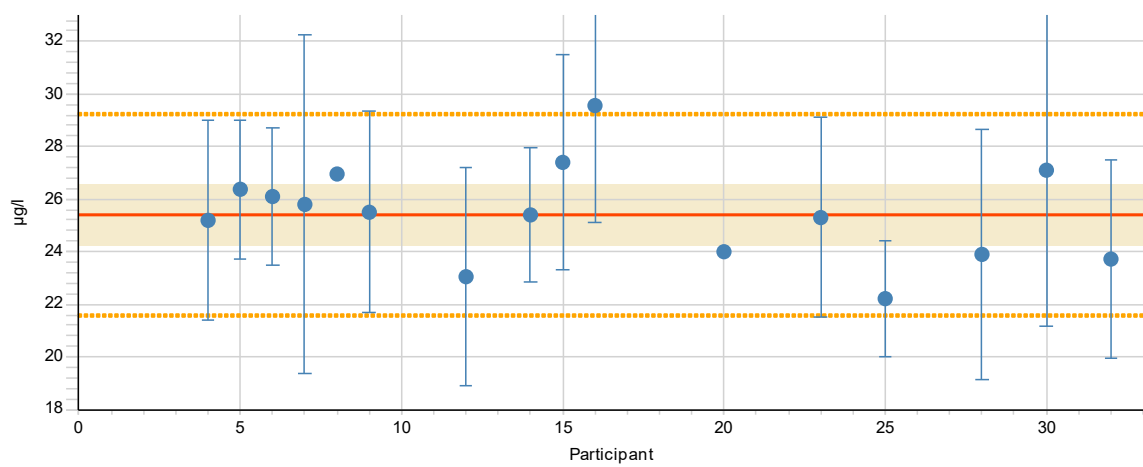


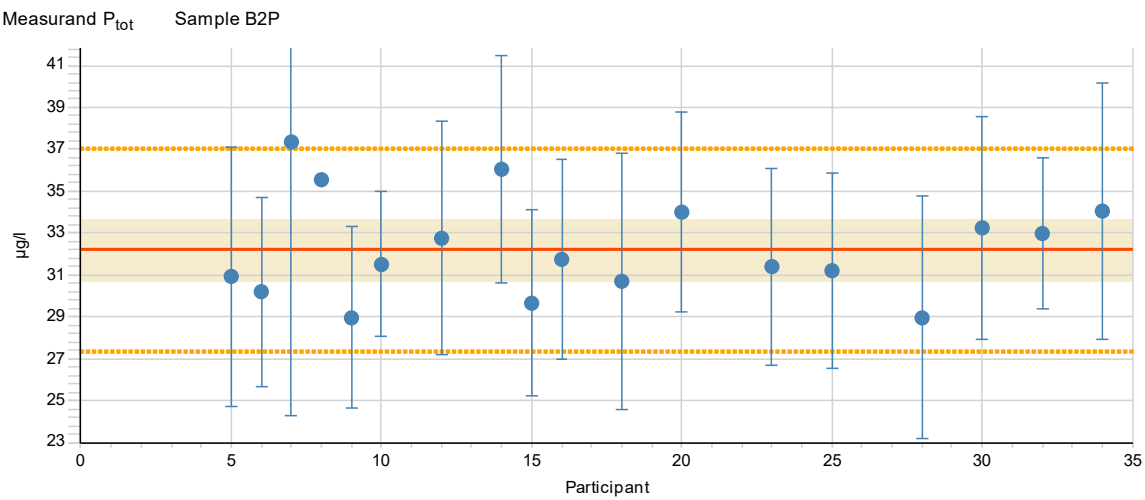
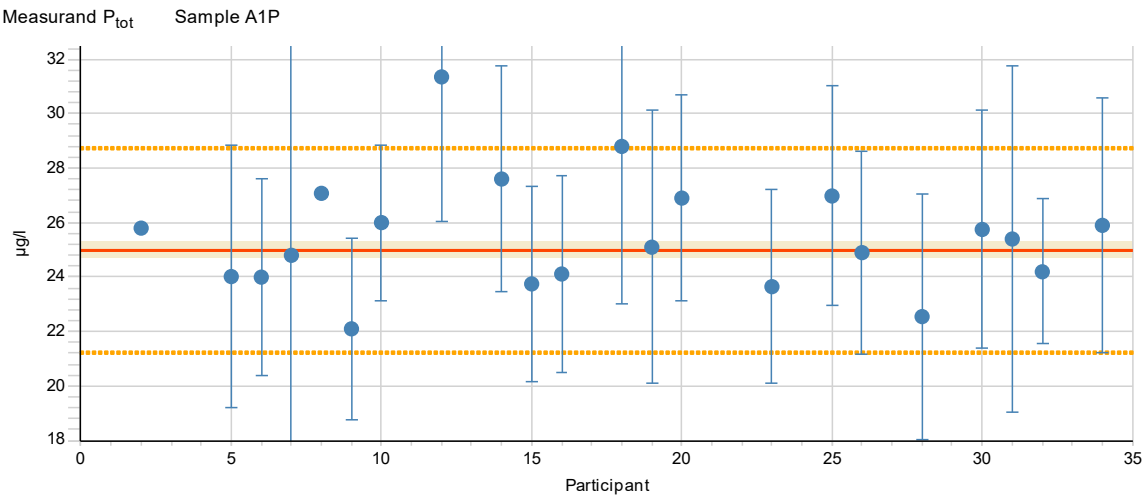
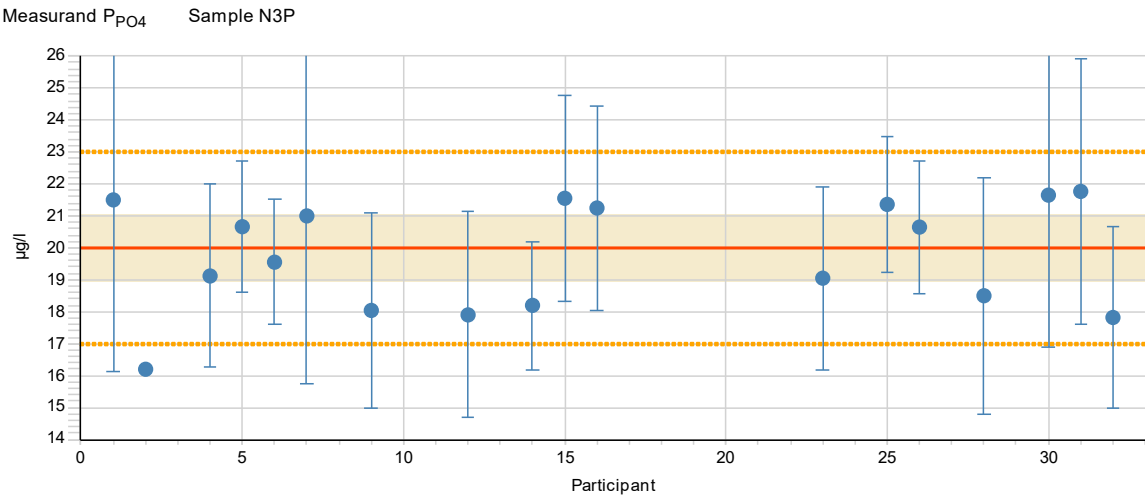
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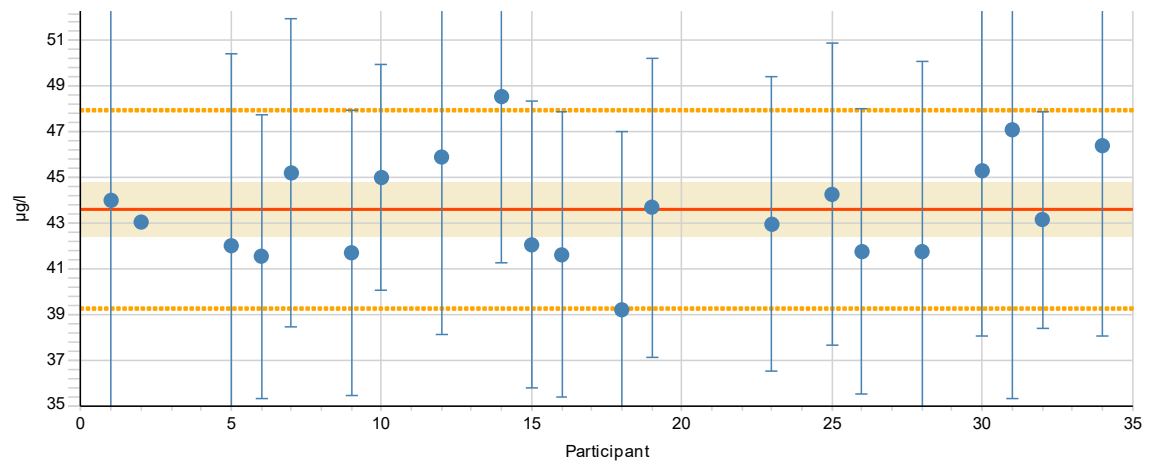




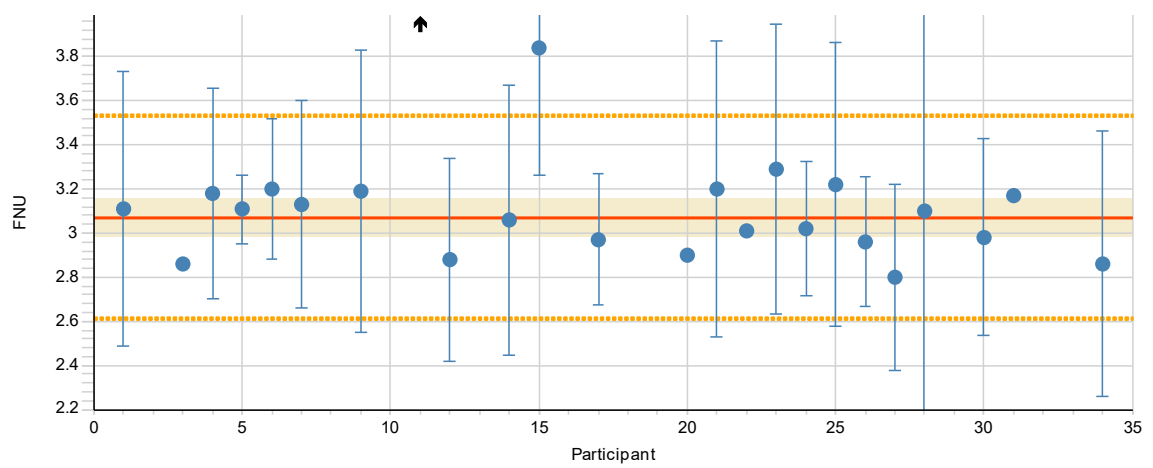
Measurand pH Sample N3H

Measurand  $P_{PO_4}$  Sample A1PMeasurand  $P_{PO_4}$  Sample B2P

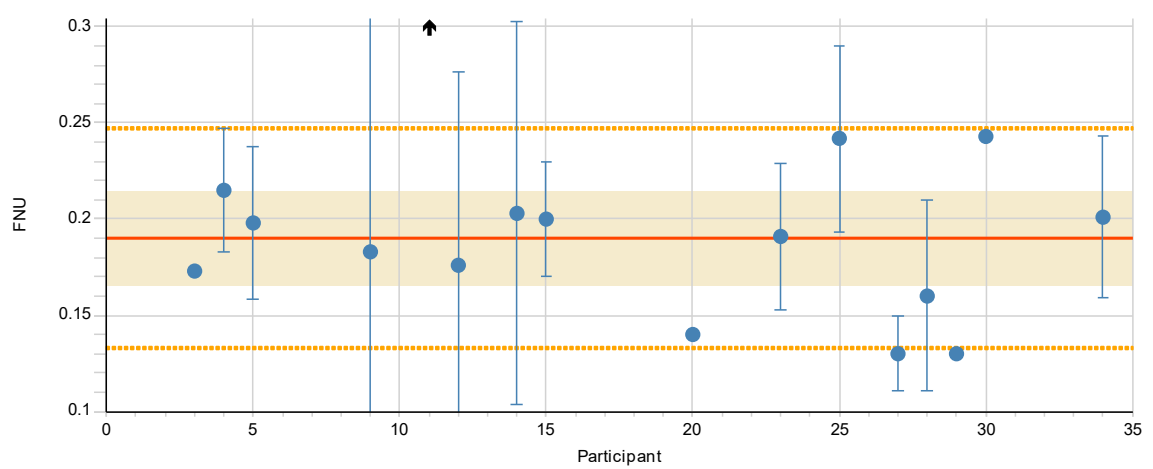


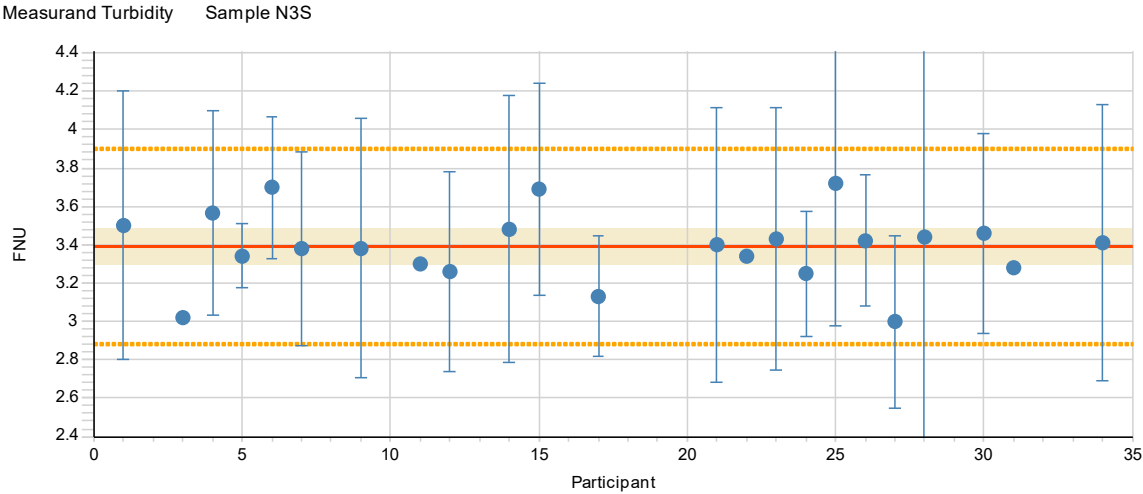
Measurand  $P_{\text{tot}}$  Sample N3P

Measurand Turbidity Sample A1S



Measurand Turbidity Sample B2S





## Appendix 10. Summary of the z scores

Measurand	Sample	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	%
Chlorophyll <i>a</i>	A1K	S	.	.	S	U	S	S	.	.	.	.	S	.	S	S	.	.	.	.	.	.	.	S	86.7
	B2K	S	.	.	S	S	S	S	.	.	.	.	S	.	q	S	.	.	.	.	.	.	.	S	85.7
	N3K	S	.	.	S	S	S	S	.	.	.	.	S	.	S	S	.	.	.	.	.	.	.	S	100
Colour <sub>visual</sub>	A1V	S	.	S	S	S	S	S	.	S	.	.	u	.	.	.	.	.	.	.	.	q	.	.	75.0
	B2S	S	.	U	S	S	S	S	.	S	.	.	U	.	.	.	.	.	.	.	.	.	.	.	70.0
	N3S	S	.	u	S	S	S	S	.	S	.	.	u	.	.	.	.	.	.	.	.	S	.	.	83.3
Colour <sub>Spectrophotometric</sub>	A1V	.	.	.	S	S	.	S	.	S	.	.	.	.	S	S	.	S	.	.	.	.	S	S	100
	B2S	.	.	.	S	S	.	S	.	S	.	.	.	.	S	S	.	.	.	.	.	.	.	S	90.9
	N3S	.	.	.	S	S	.	S	.	S	.	.	.	.	S	U	.	S	.	.	.	.	S	S	78.6
Conductivity 25	A1J	S	S	U	S	Q	S	S	.	S	S	S	U	S	S	U	.	S	S	.	S	S	S	S	81.5
	B2H	S	.	u	S	S	U	S	.	S	S	S	u	q	S	S	.	.	S	.	S	.	.	S	81.0
	N3H	S	S	U	S	S	S	S	.	S	S	S	u	S	S	S	.	S	S	.	.	S	S	S	88.5
N <sub>NH4</sub>	A1N	.	.	.	S	S	S	S	S	S	.	.	q	.	S	S	S	.	.	.	S	U	.	S	81.0
	B2N	.	.	.	S	S	S	S	S	S	.	.	S	.	S	S	S	.	.	.	Q	.	.	S	88.2
	N3N	S	S	.	S	S	S	S	.	S	.	.	S	.	S	S	S	.	.	.	.	S	.	S	95.2
N <sub>NO2+NO3</sub>	A1N	.	S	.	S	U	S	S	S	S	.	.	S	.	U	S	S	.	.	.	S	.	.	S	90.0
	B2N	.	.	.	q	Q	S	S	S	S	.	.	S	.	U	S	S	.	.	.	S	.	.	S	81.3
	N3N	S	S	.	S	S	S	S	.	S	.	.	S	.	U	S	S	.	.	.	.	.	.	S	94.7
N <sub>tot</sub>	A1N	.	S	.	.	U	S	S	S	S	U	.	S	.	S	S	S	.	.	.	.	.	.	S	88.9
	B2N	.	.	.	.	S	S	S	S	S	S	.	S	.	S	S	S	.	.	.	.	.	.	S	87.5
	N3N	S	S	.	.	S	S	S	.	S	S	.	S	.	S	S	S	.	.	.	.	.	.	S	100
pH	A1H	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	.	S	S	S	S	100
	B2H	S	.	S	S	S	S	S	S	S	S	S	S	S	S	S	u	.	S	.	S	.	.	S	95.8
	N3H	S	.	S	S	S	S	S	.	S	S	S	S	S	S	S	S	S	S	.	.	S	S	q	96.2
P <sub>PO4</sub>	A1P	.	S	.	q	S	S	S	S	S	.	.	u	.	S	U	S	.	.	.	S	.	.	S	73.7
	B2P	.	.	.	S	S	S	S	S	S	.	.	S	.	S	S	Q	.	.	.	S	.	.	S	93.8
	N3P	S	q	.	S	S	S	S	.	S	.	.	S	.	S	S	S	.	.	.	.	.	.	S	94.4
P <sub>tot</sub>	A1P	.	S	.	.	S	S	S	S	S	S	.	U	.	S	S	S	.	Q	S	S	.	.	S	90.9
	B2P	.	.	.	.	S	S	Q	S	S	S	.	S	.	S	S	S	.	S	.	S	.	.	S	94.4
	N3P	S	S	.	.	S	S	S	.	S	S	.	S	.	Q	S	S	.	q	S	.	.	.	S	90.5
Turbidity	A1S	S	.	S	S	S	S	S	.	S	.	U	S	.	S	U	.	S	.	.	S	S	S	S	91.7
	B2S	.	.	S	S	S	.	.	.	S	.	U	S	.	S	S	.	.	.	.	S	.	.	S	81.3
	N3S	S	.	S	S	S	S	S	.	S	.	S	S	.	S	S	.	S	.	.	.	S	S	S	100
% accredited		100	92	58	93	85	97	97	100	100	92	78	70	83	83	87	89	100	78	100	93	80	100	97	
		14	8	7	25	30	25	29		30		4	30	6	29	30	16	5	9	2		8		30	

## Appendix 10 (2/2)

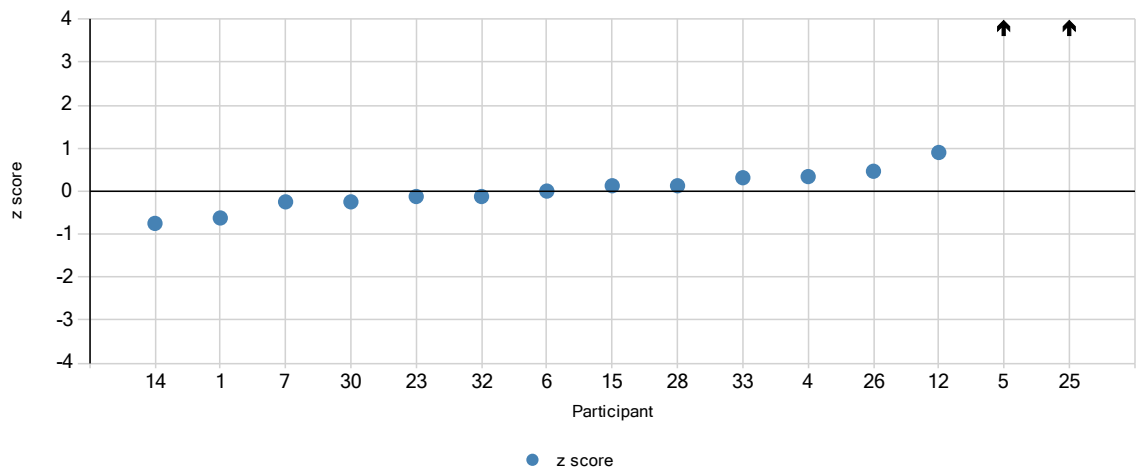
Measurand	Sample	24	25	26	27	28	29	30	31	32	33	34		%
Chlorophyll <i>a</i>	A1K	.	<b>U</b>	<b>S</b>	.	<b>S</b>	.	<i>S</i>	.	<b>S</b>	<b>S</b>	.	.	86.7
	B2K	.	<b>S</b>	<b>S</b>	.	<b>S</b>	.	<i>S</i>	.	<b>u</b>	.	.	.	85.7
	N3K	.	<b>S</b>	<b>S</b>	.	<b>S</b>	.	<i>S</i>	.	<b>S</b>	.	.	.	100
Colour <sub>Visual</sub>	A1V	.	.	.	.	.	.	<b>S</b>	<i>q</i>	.	.	<b>S</b>	.	75.0
	B2S	.	.	.	.	.	.	<b>Q</b>	.	.	.	<i>S</i>	.	70.0
	N3S	.	.	.	.	.	.	<b>S</b>	<i>S</i>	.	.	<b>S</b>	.	83.3
Colour <sub>Spectrophotometric</sub>	A1V	<b>S</b>	<b>S</b>	<b>S</b>	<b>S</b>	<b>S</b>	.	.	.	.	.	.	.	100
	B2S	.	<b>S</b>	.	<b>S</b>	<b>U</b>	<i>S</i>	.	.	.	.	.	.	90.9
	N3S	<b>S</b>	<b>S</b>	<b>S</b>	<b>Q</b>	<b>U</b>	.	.	.	.	.	.	.	78.6
Conductivity 25	A1J	.	<b>S</b>	<b>S</b>	<i>q</i>	<b>S</b>	.	<b>S</b>	<i>S</i>	.	.	<b>S</b>	.	81.5
	B2H	.	<b>S</b>	.	<b>S</b>	<b>S</b>	.	<b>S</b>	.	.	.	<i>S</i>	.	81.0
	N3H	.	<b>S</b>	<b>S</b>	<b>u</b>	<b>S</b>	.	<b>S</b>	<i>S</i>	.	.	<b>S</b>	.	88.5
N <sub>NH4</sub>	A1N	<b>S</b>	<b>S</b>	<b>S</b>	.	<b>S</b>	.	<b>S</b>	<i>Q</i>	<b>U</b>	.	<b>S</b>	.	81.0
	B2N	.	<b>S</b>	.	.	<b>S</b>	.	<b>S</b>	.	<b>Q</b>	.	<i>S</i>	.	88.2
	N3N	<b>S</b>	<b>S</b>	<b>S</b>	.	<b>S</b>	.	<b>S</b>	<i>S</i>	<b>U</b>	.	<b>S</b>	.	95.2
N <sub>NO2+NO3</sub>	A1N	<b>S</b>	<b>S</b>	<b>S</b>	.	<b>S</b>	.	<b>S</b>	<i>S</i>	<b>S</b>	.	.	.	90.0
	B2N	.	<b>S</b>	.	.	<b>S</b>	.	<b>S</b>	.	<b>S</b>	.	.	.	81.3
	N3N	<b>S</b>	<b>S</b>	<b>S</b>	.	<b>S</b>	.	<b>S</b>	<i>S</i>	<b>S</b>	.	.	.	94.7
N <sub>tot</sub>	A1N	.	<b>S</b>	<b>S</b>	.	<b>S</b>	.	<b>S</b>	.	<b>S</b>	.	<b>S</b>	.	88.9
	B2N	.	<i>q</i>	.	.	<b>S</b>	.	<b>S</b>	.	<b>S</b>	.	<i>u</i>	.	87.5
	N3N	.	<b>S</b>	<b>S</b>	.	<b>S</b>	.	<b>S</b>	.	<b>S</b>	.	<b>S</b>	.	100
pH	A1H	.	<b>S</b>	<b>S</b>	<b>S</b>	<b>S</b>	.	<b>S</b>	<i>S</i>	<b>S</b>	.	<b>S</b>	.	100
	B2H	.	<b>S</b>	.	<b>S</b>	<b>S</b>	<b>S</b>	<b>S</b>	.	.	.	<i>S</i>	.	95.8
	N3H	.	<b>S</b>	<b>S</b>	<b>S</b>	<b>S</b>	.	<b>S</b>	<i>S</i>	.	.	<b>S</b>	.	96.2
P <sub>PO4</sub>	A1P	.	<b>S</b>	<b>S</b>	.	<b>u</b>	.	<b>S</b>	<i>S</i>	<b>u</b>	.	.	.	73.7
	B2P	.	<b>S</b>	.	.	<b>S</b>	.	<b>S</b>	.	<b>S</b>	.	.	.	93.8
	N3P	.	<b>S</b>	<b>S</b>	.	<b>S</b>	.	<b>S</b>	<i>S</i>	<b>S</b>	.	.	.	94.4
P <sub>tot</sub>	A1P	.	<b>S</b>	<b>S</b>	.	<b>S</b>	.	<b>S</b>	<i>S</i>	<b>S</b>	.	<b>S</b>	.	90.9
	B2P	.	<b>S</b>	.	.	<b>S</b>	.	<b>S</b>	.	<b>S</b>	.	<i>S</i>	.	94.4
	N3P	.	<b>S</b>	<b>S</b>	.	<b>S</b>	.	<b>S</b>	<i>S</i>	<b>S</b>	.	<b>S</b>	.	90.5
Turbidity	A1S	<b>S</b>	<b>S</b>	<b>S</b>	<b>S</b>	<b>S</b>	.	<b>S</b>	<i>S</i>	.	.	<b>S</b>	.	91.7
	B2S	.	<b>S</b>	.	<i>q</i>	<b>S</b>	<i>q</i>	<b>S</b>	.	.	.	<i>S</i>	.	81.3
	N3S	<b>S</b>	<b>S</b>	<b>S</b>	<b>S</b>	<b>S</b>	.	<b>S</b>	<i>S</i>	.	.	<b>S</b>	.	100
%		100	93	100	67	90	67	97	88	74	100	95		
accredited		8	30	20	11	30	1	27		19	1	14		

S - satisfactory ( $-2 \leq z \leq 2$ ), Q - questionable ( $2 < z < 3$ ), q - questionable ( $-3 < z < -2$ ),  
U - unsatisfactory ( $z \geq 3$ ), and u - unsatisfactory ( $z \leq -3$ ), respectively  
bold - accredited, italics - non-accredited, normal - unknown  
% - percentage of satisfactory results

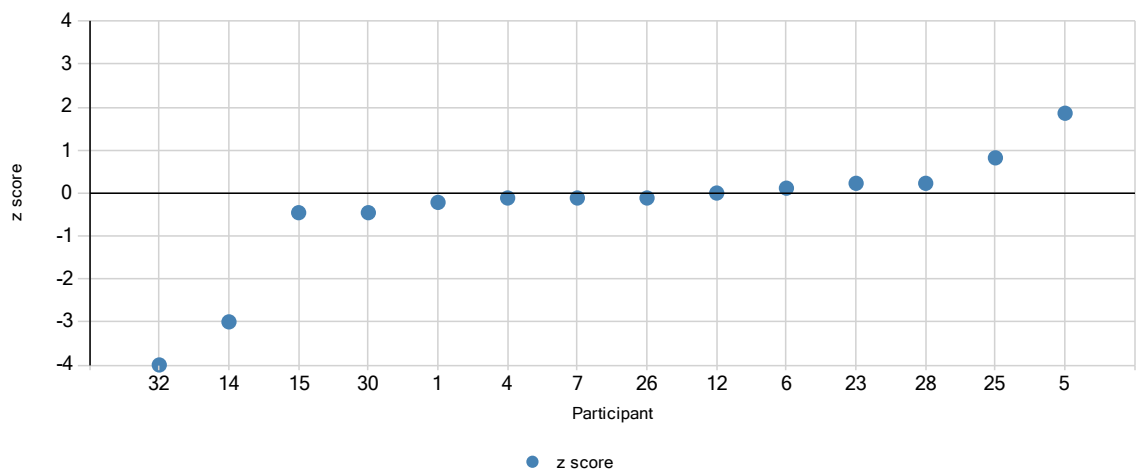
Totally satisfactory, % in all: 90      % in accredited: 90      % in non-accredited: 88

## Appendix I I. z scores in ascending order

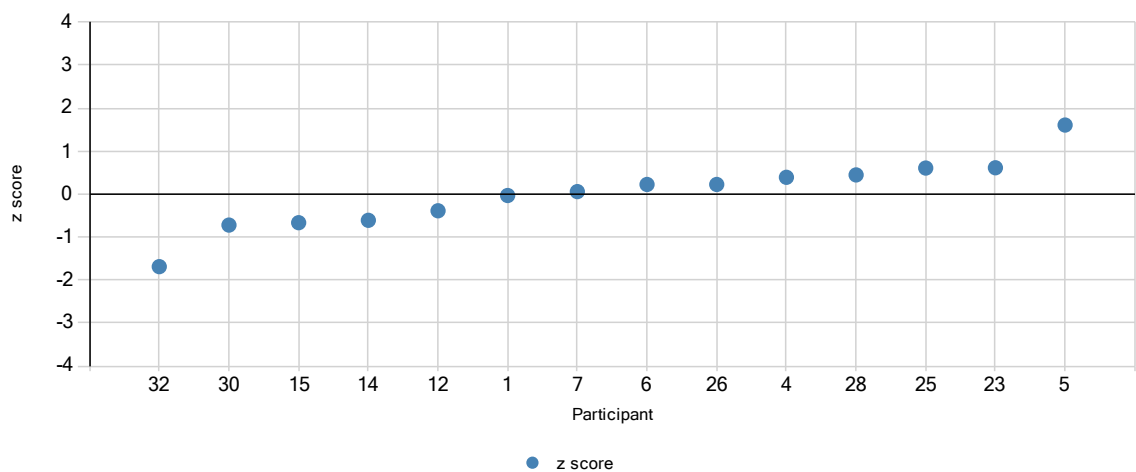
Measurand Chlorophyll a Sample A1K

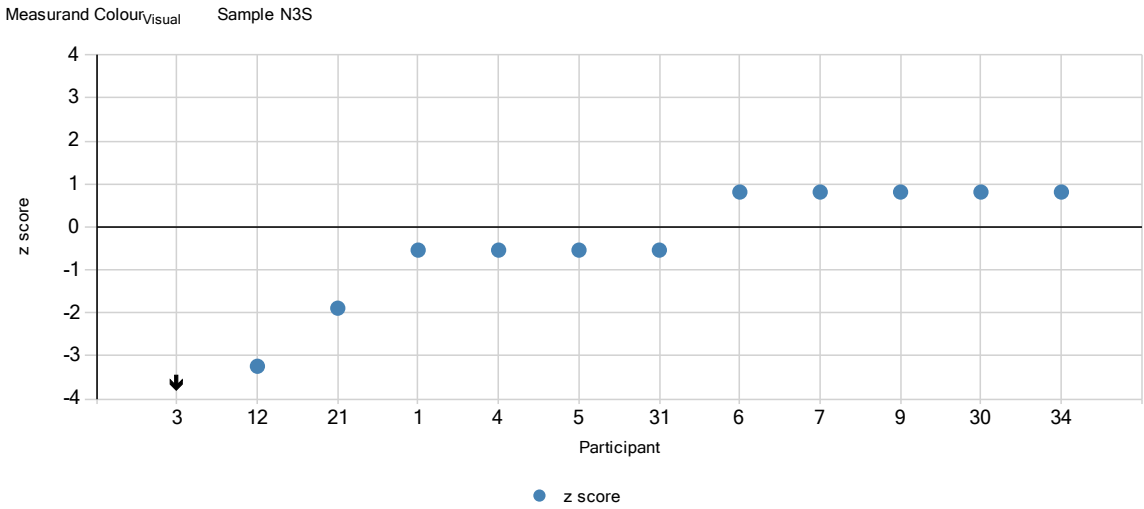
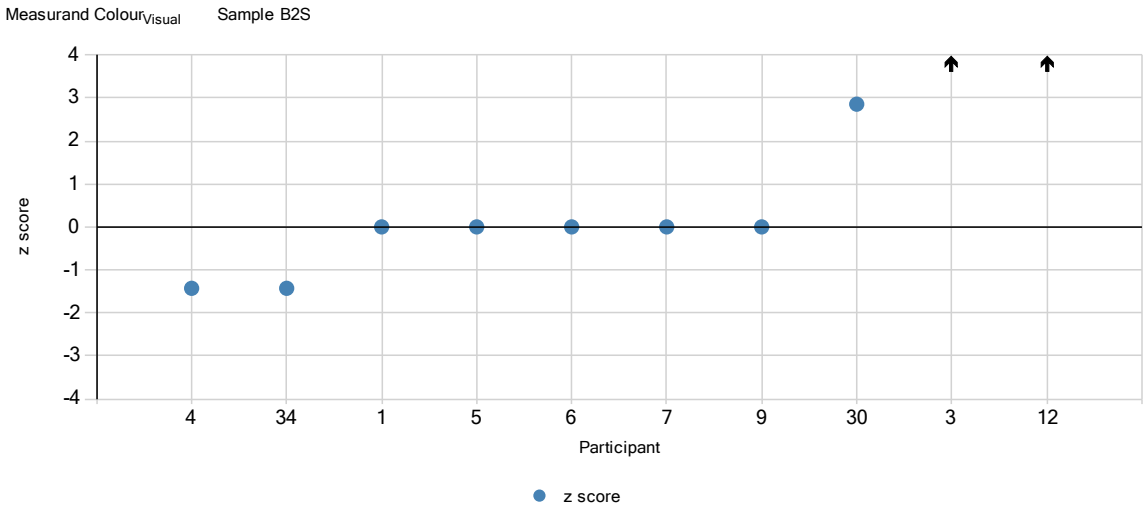
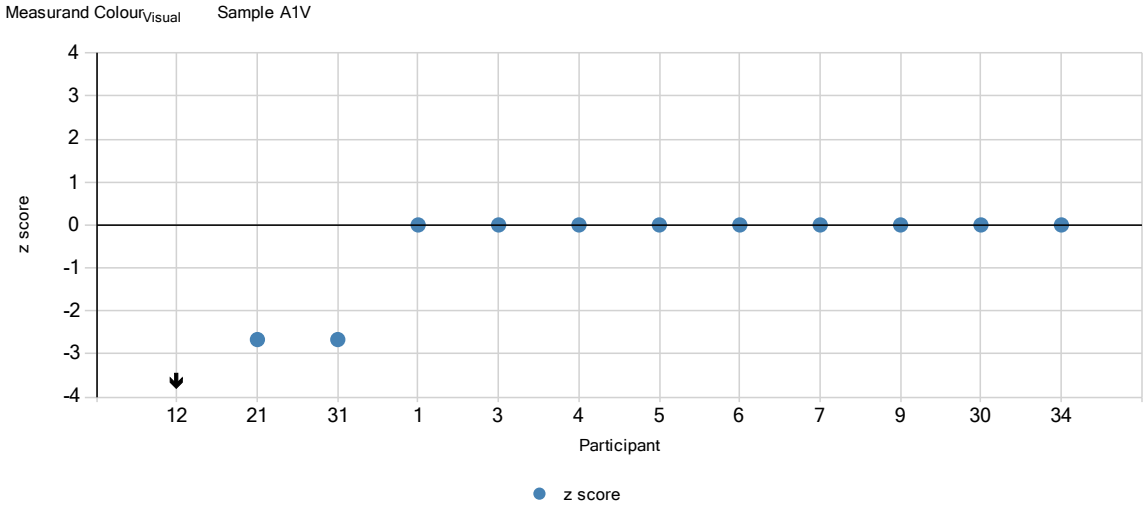


Measurand Chlorophyll a Sample B2K



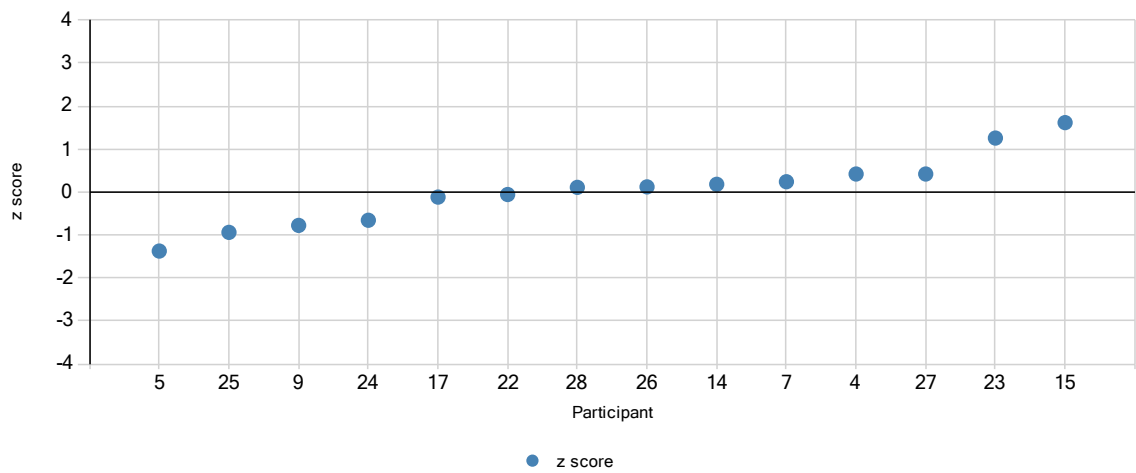
Measurand Chlorophyll a Sample N3K



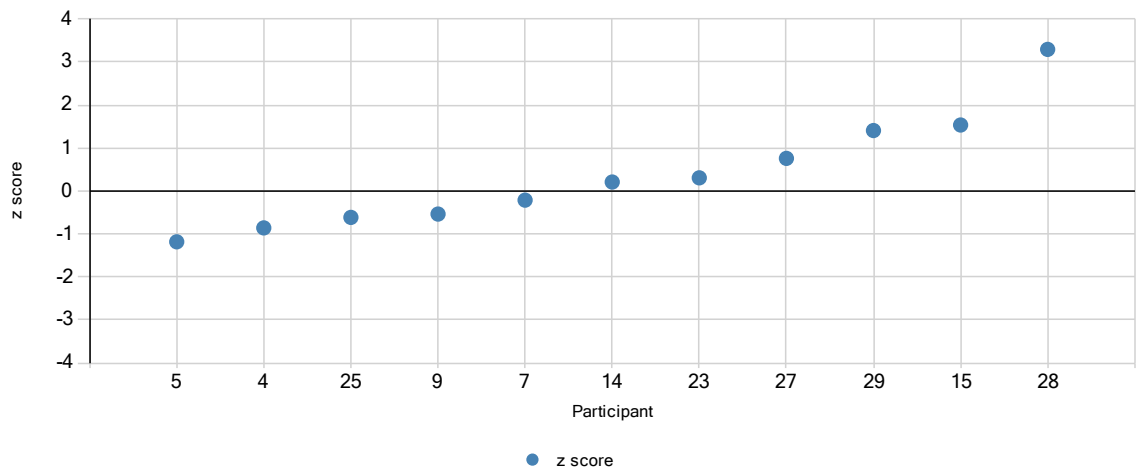




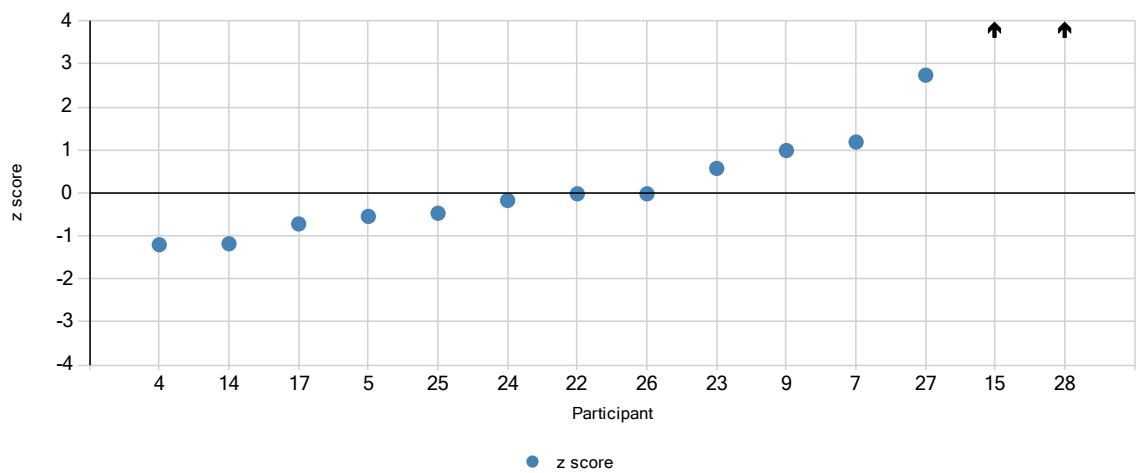
Measurand Colour<sub>Spectrophotometric</sub> Sample A1V

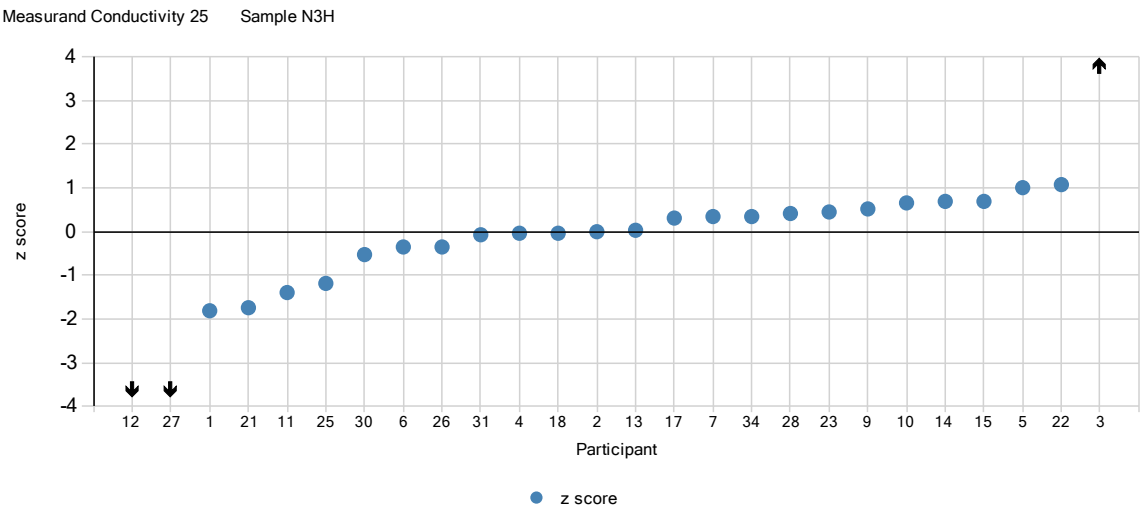
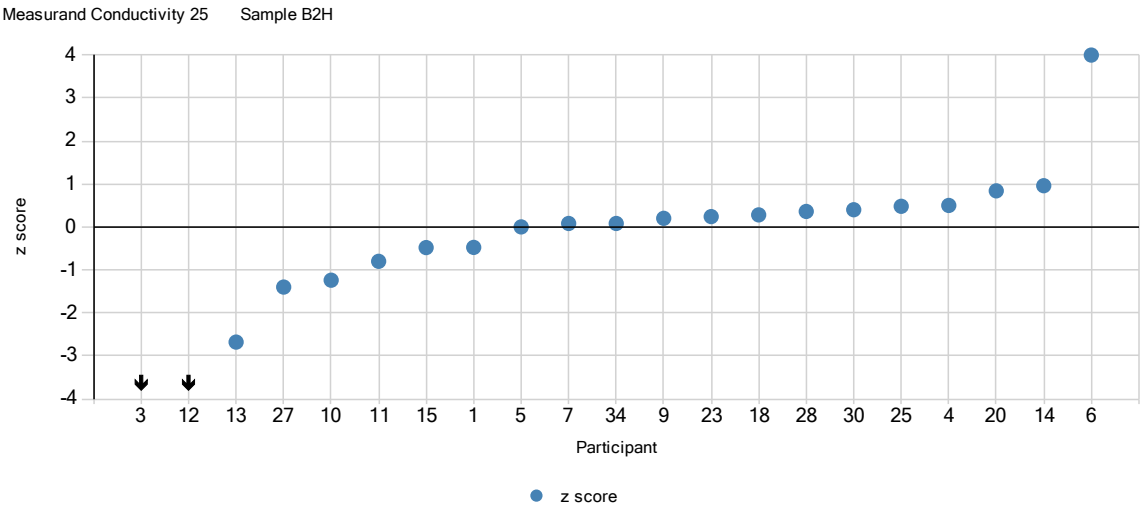
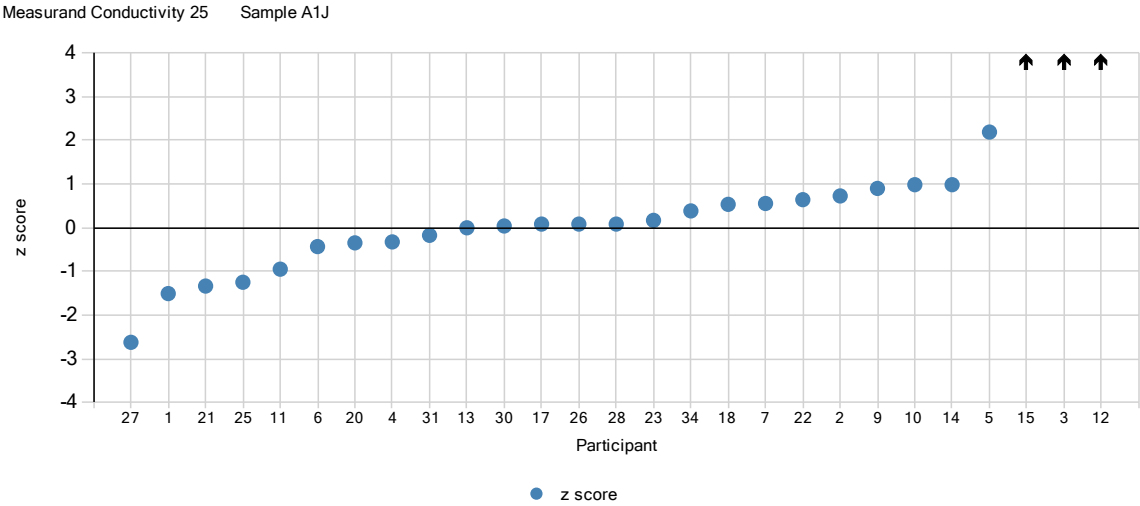


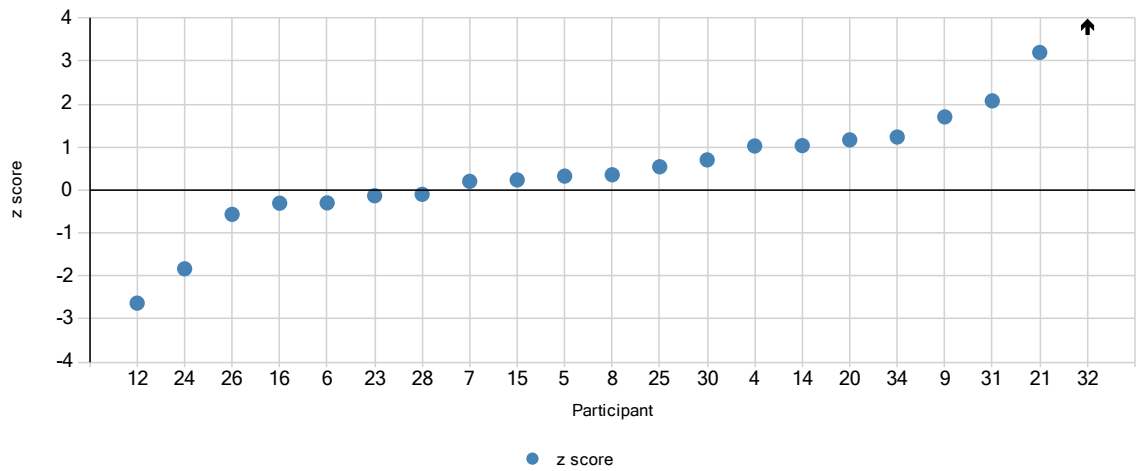
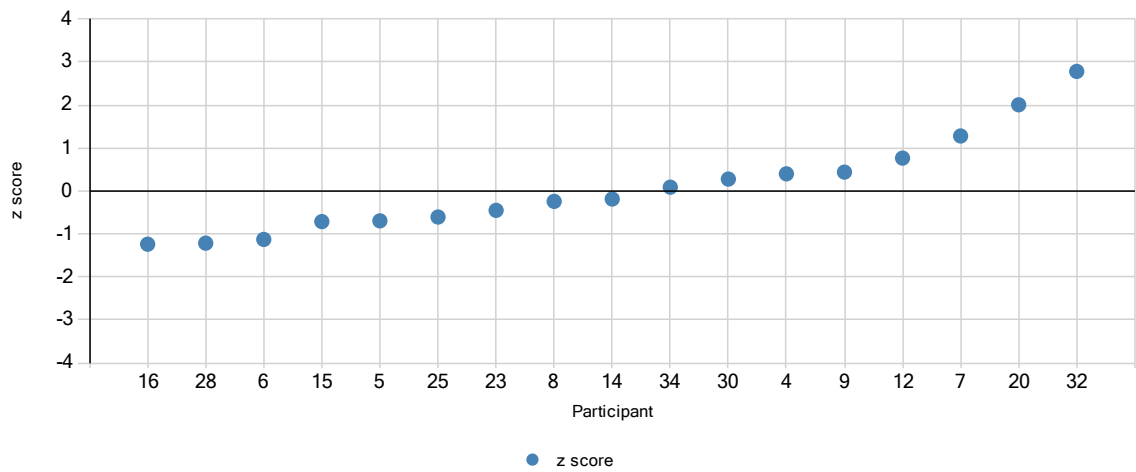
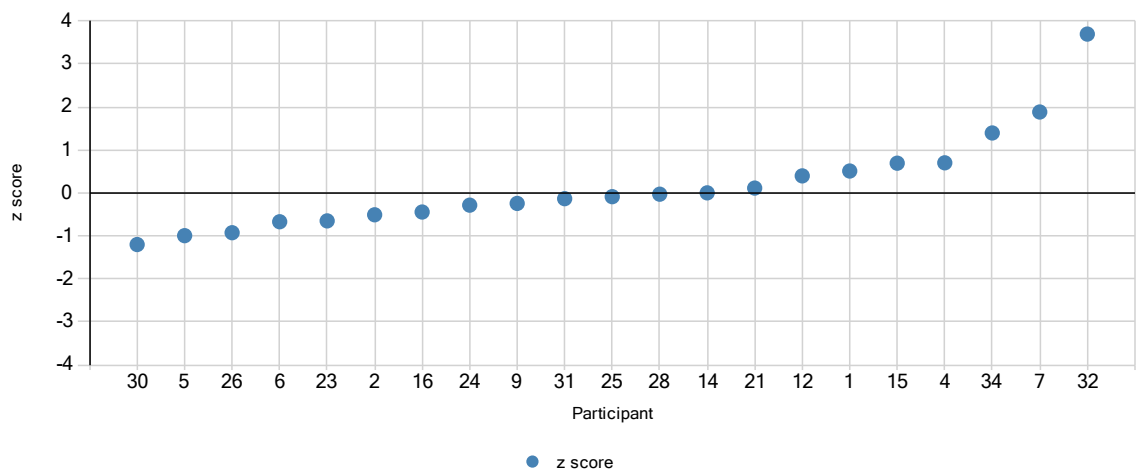
Measurand Colour<sub>Spectrophotometric</sub> Sample B2S

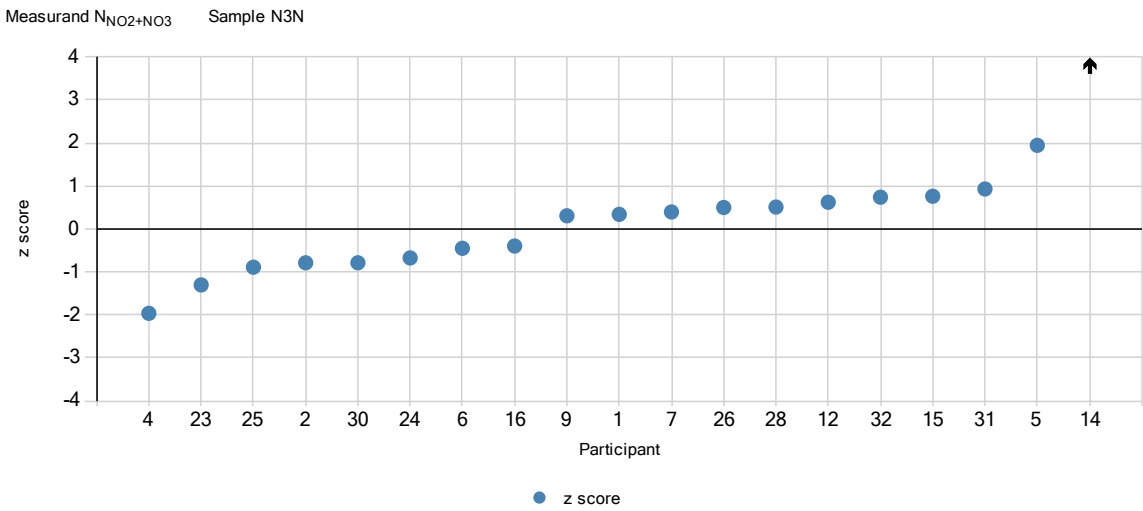
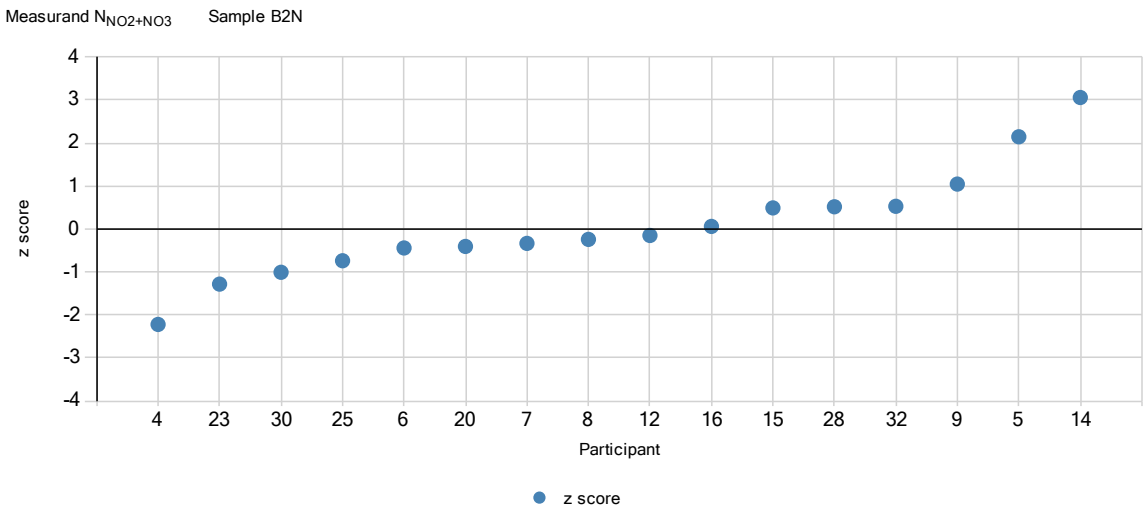
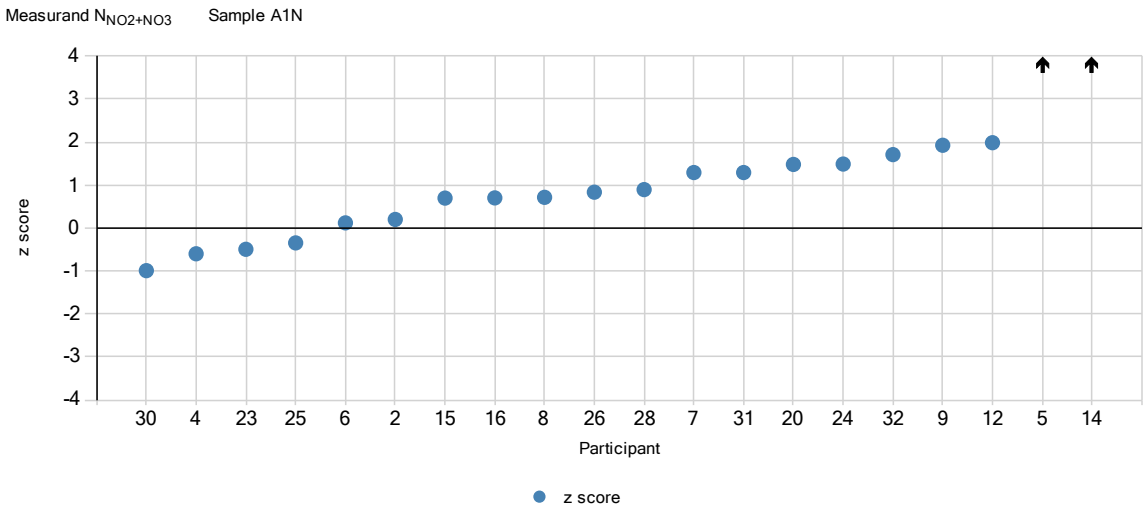


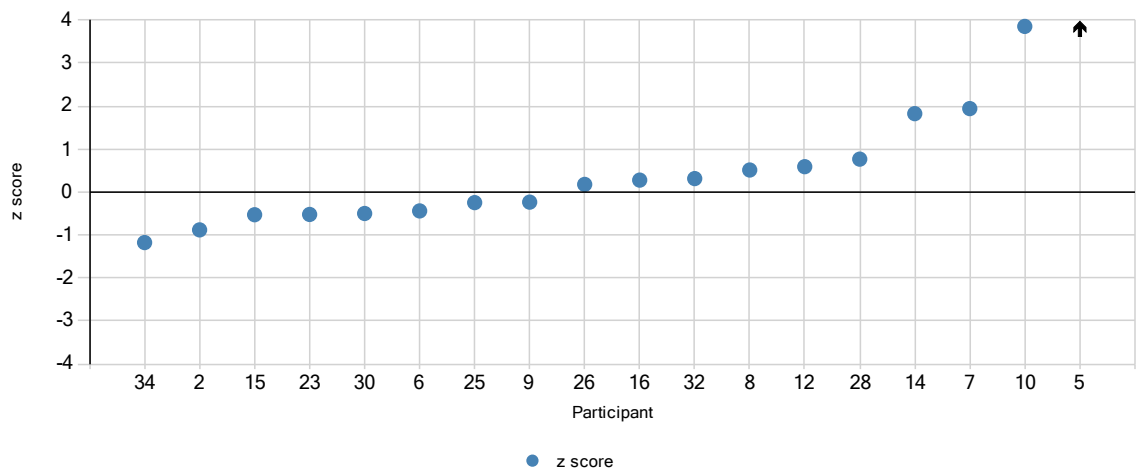
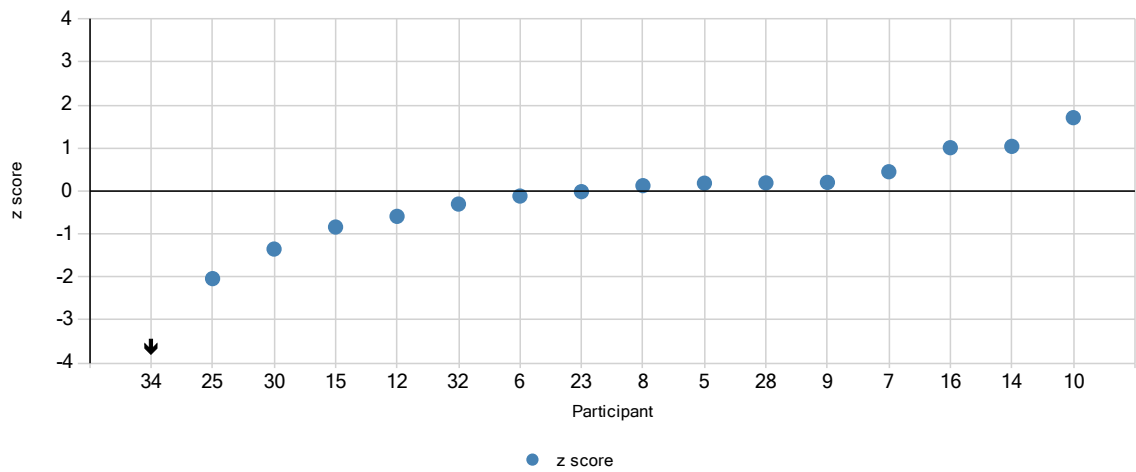
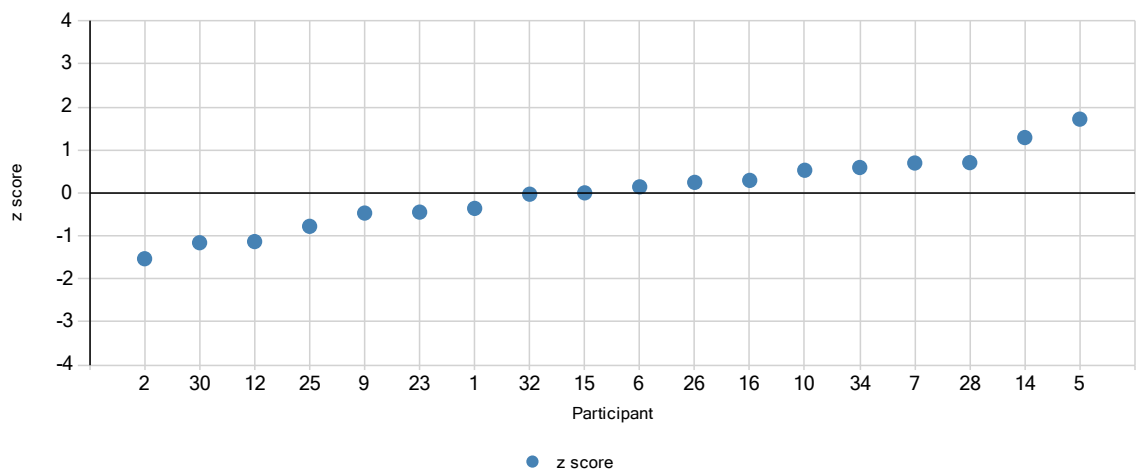
Measurand Colour<sub>Spectrophotometric</sub> Sample N3S

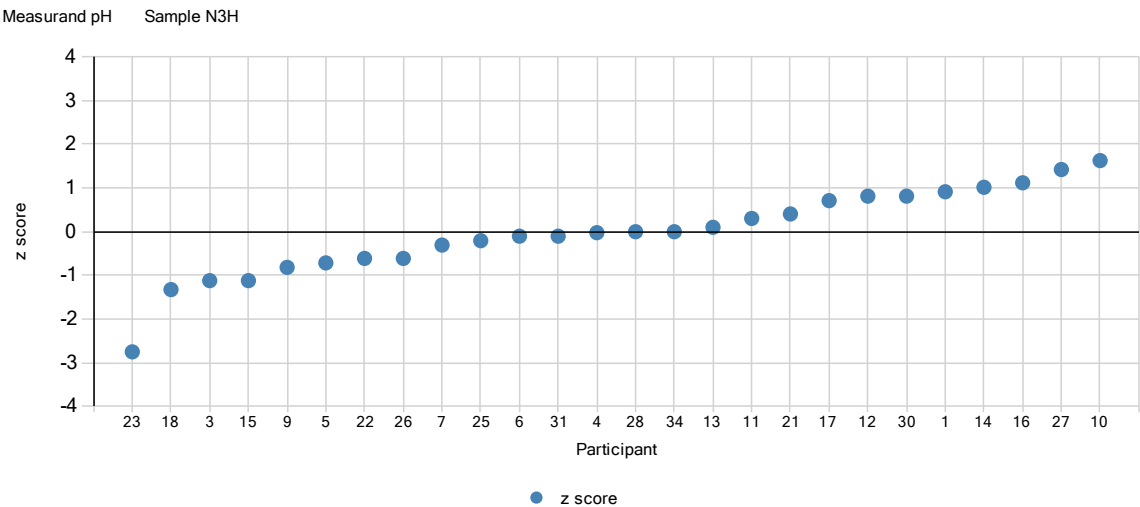
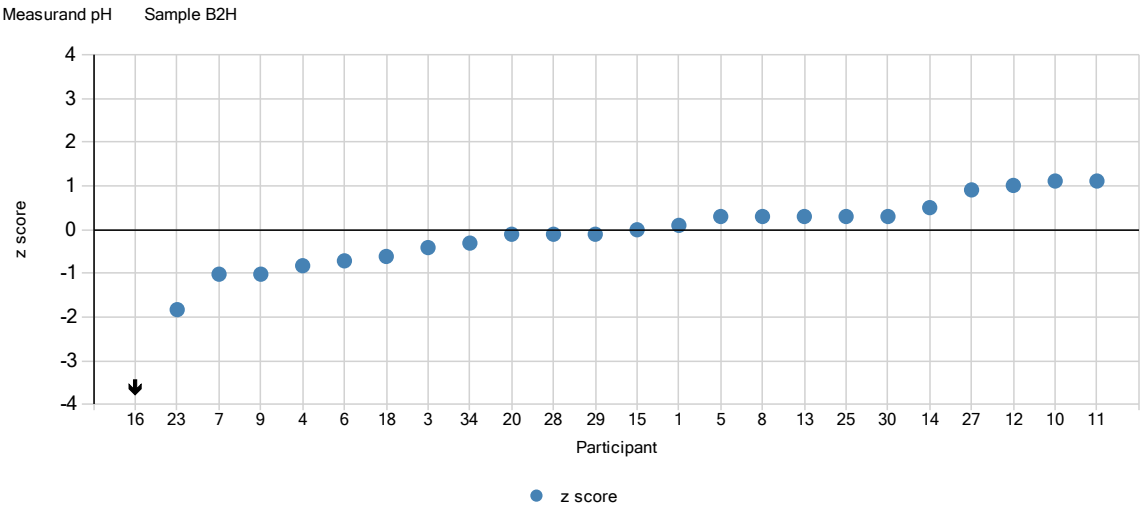
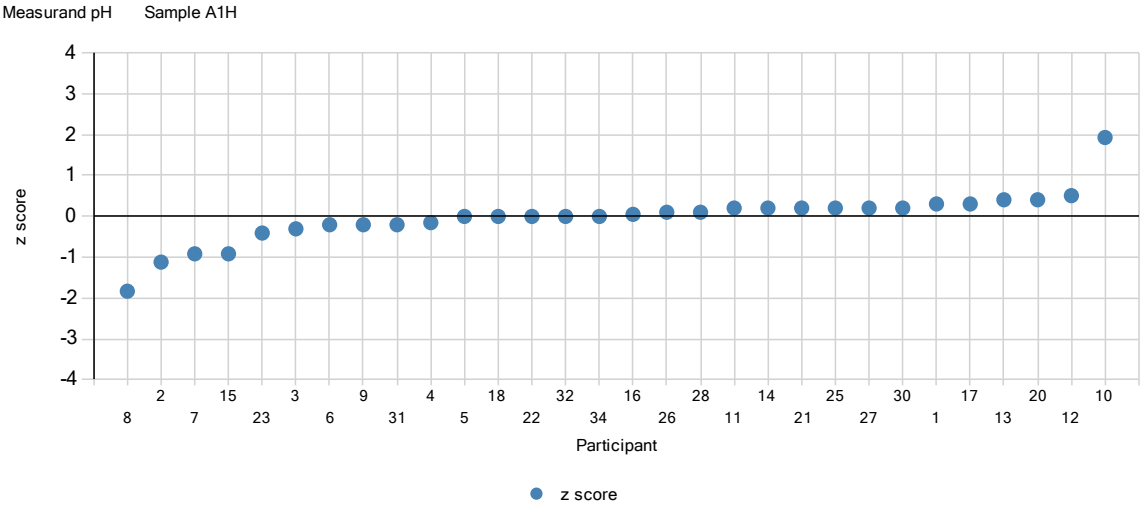


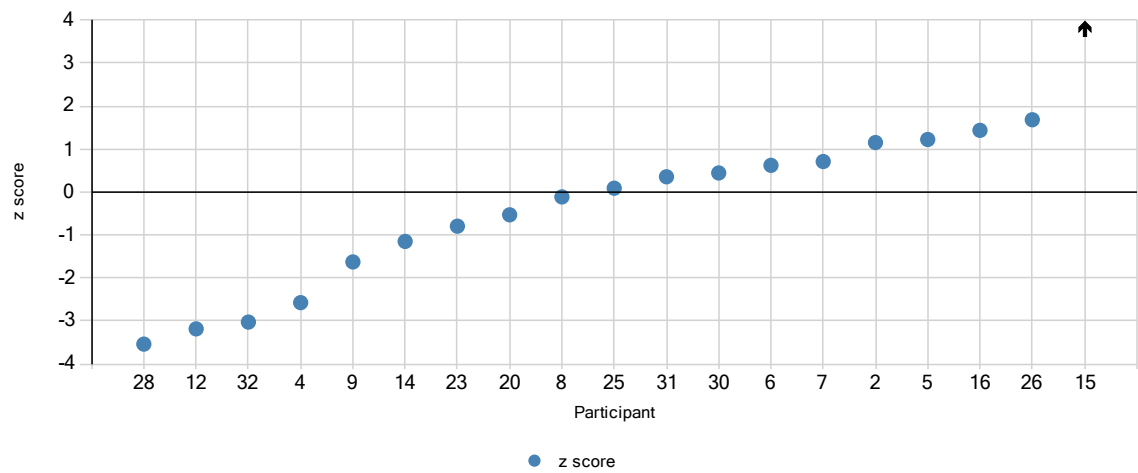
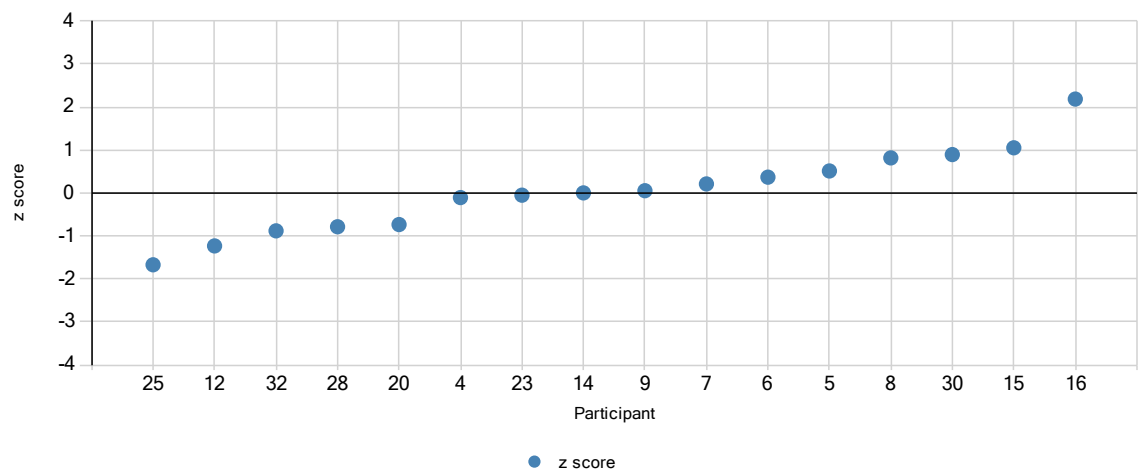
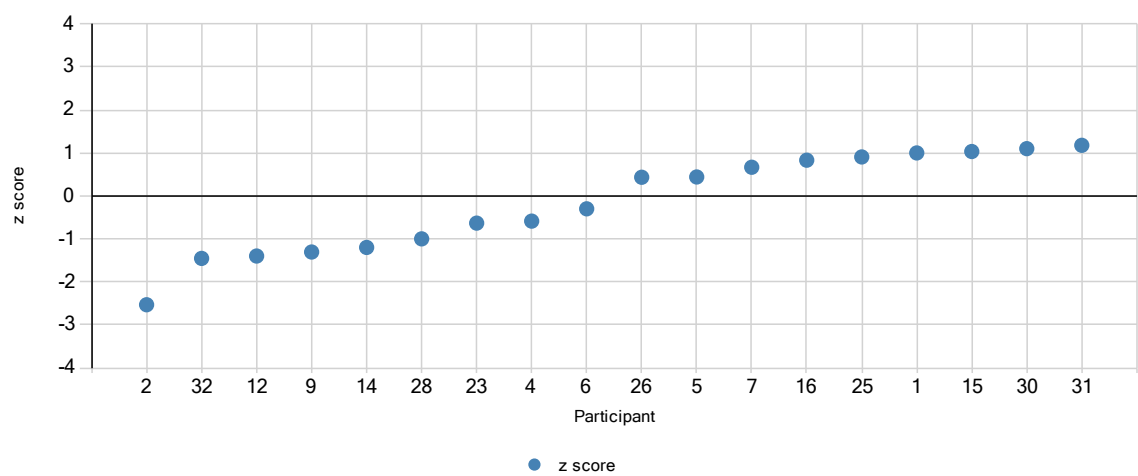


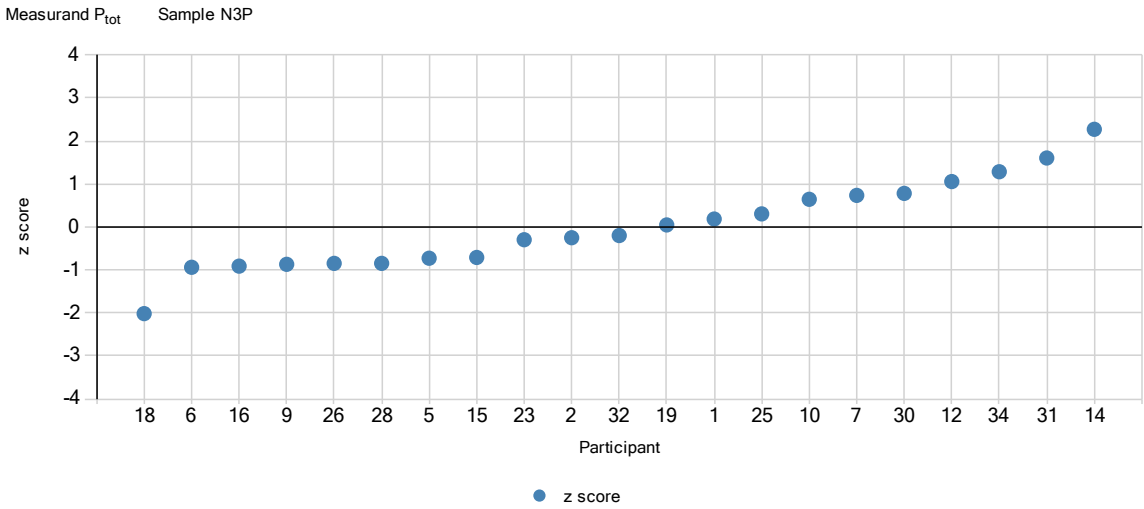
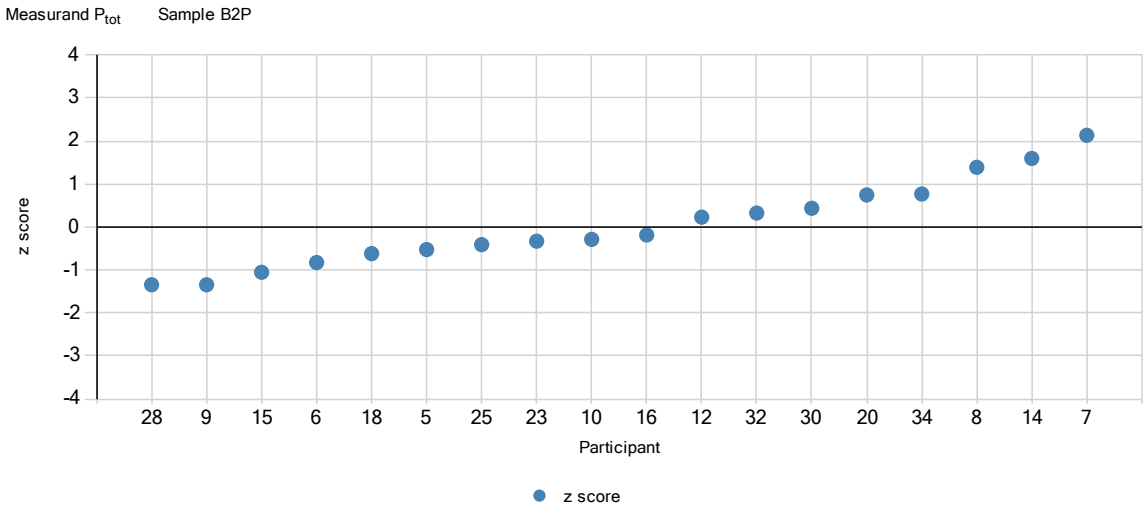
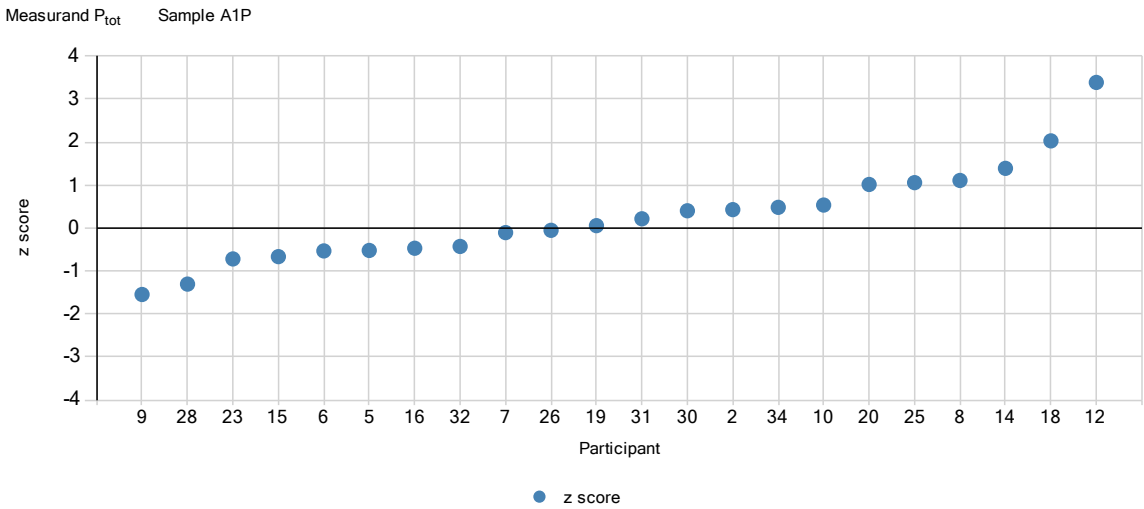
Measurand  $N_{NH4}$  Sample A1N

Measurand  $N_{NH4}$  Sample B2N

Measurand  $N_{NH4}$  Sample N3N




Measurand  $N_{tot}$  Sample A1NMeasurand  $N_{tot}$  Sample B2NMeasurand  $N_{tot}$  Sample N3N

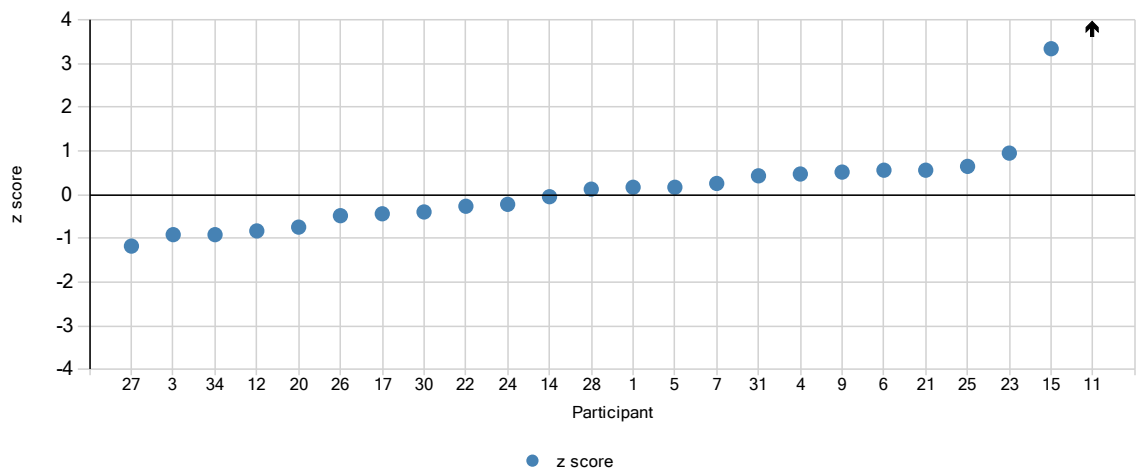


Measurand P<sub>PO4</sub> Sample A1PMeasurand P<sub>PO4</sub> Sample B2PMeasurand P<sub>PO4</sub> Sample N3P

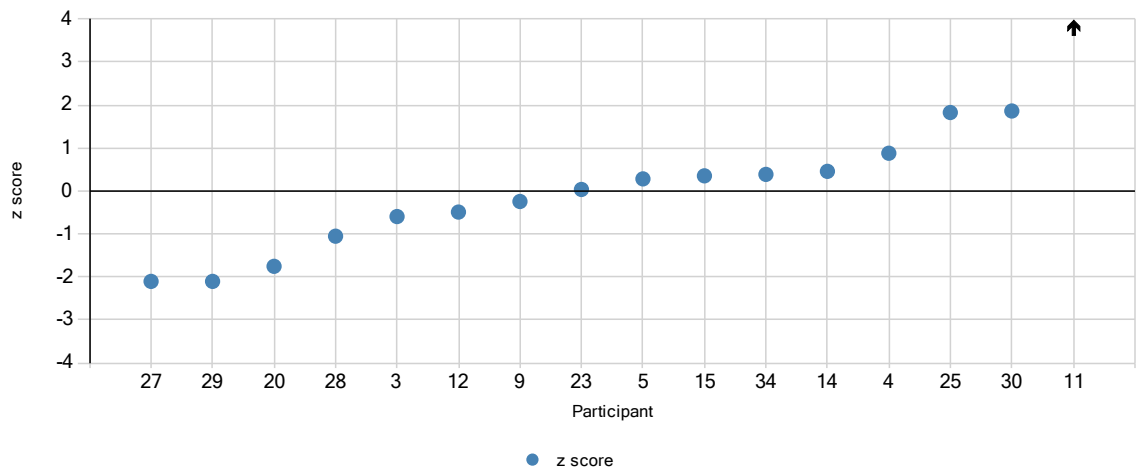




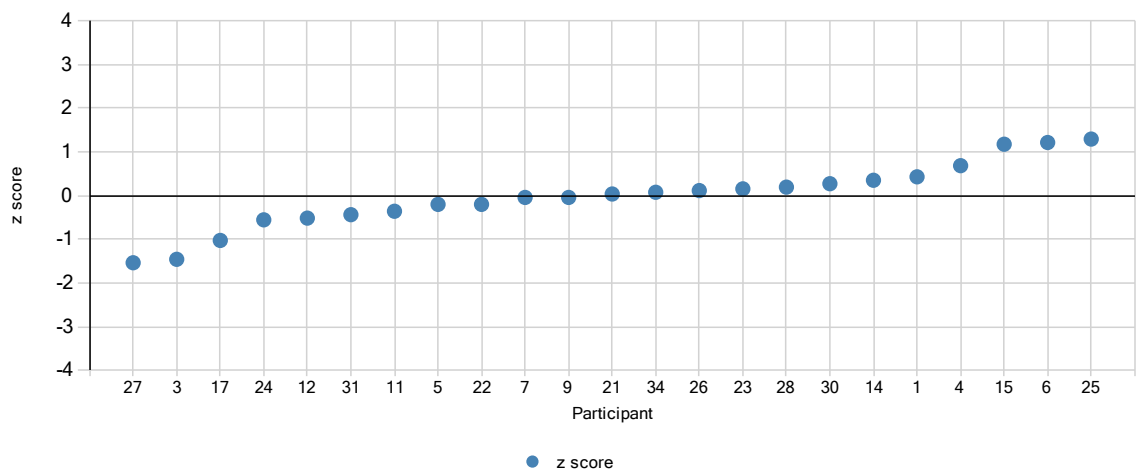
Measurand Turbidity Sample A1S



Measurand Turbidity Sample B2S

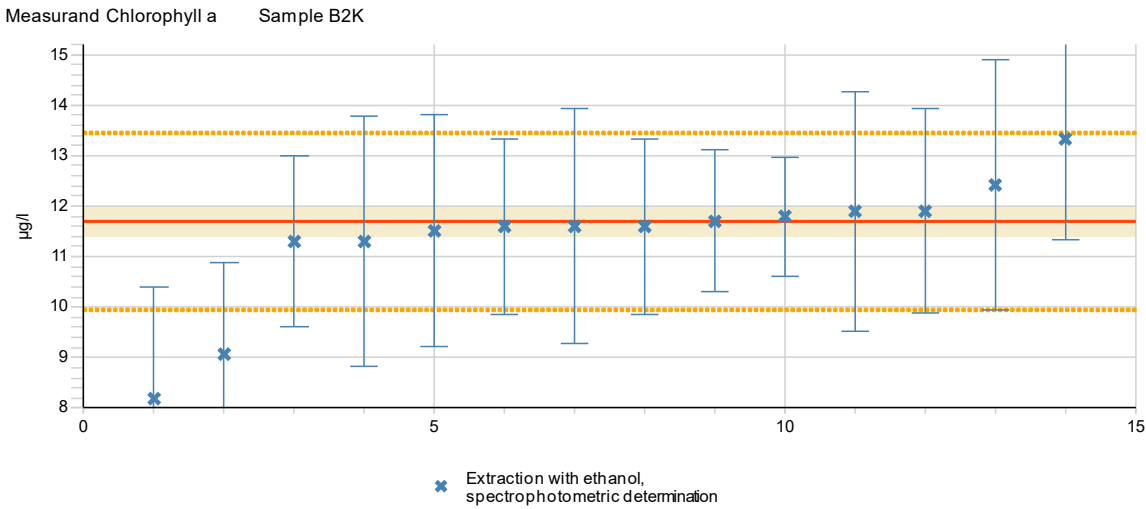
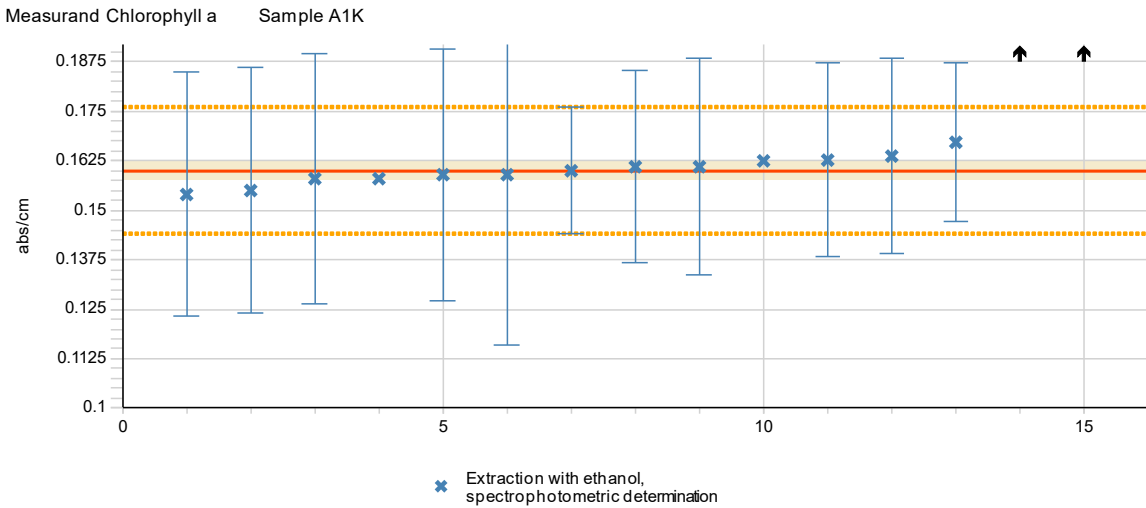


Measurand Turbidity Sample N3S

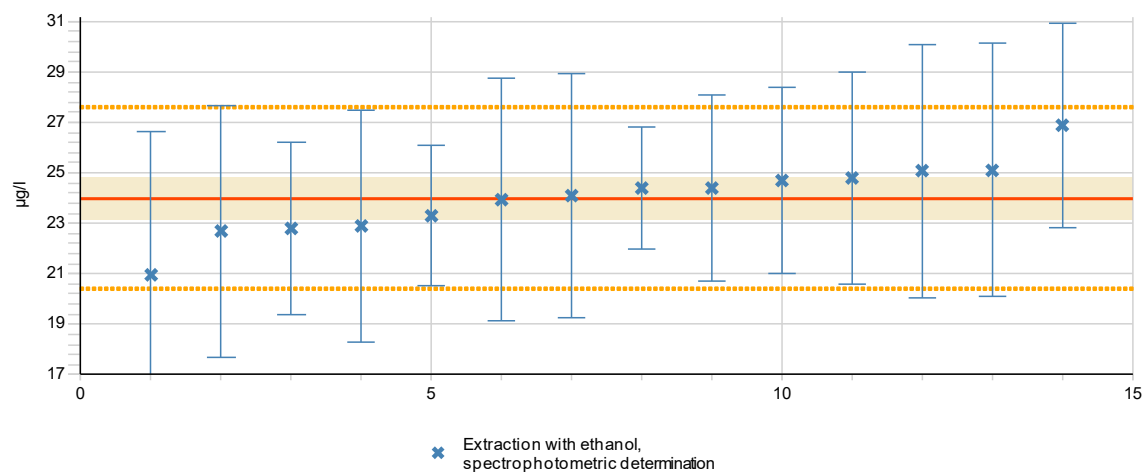
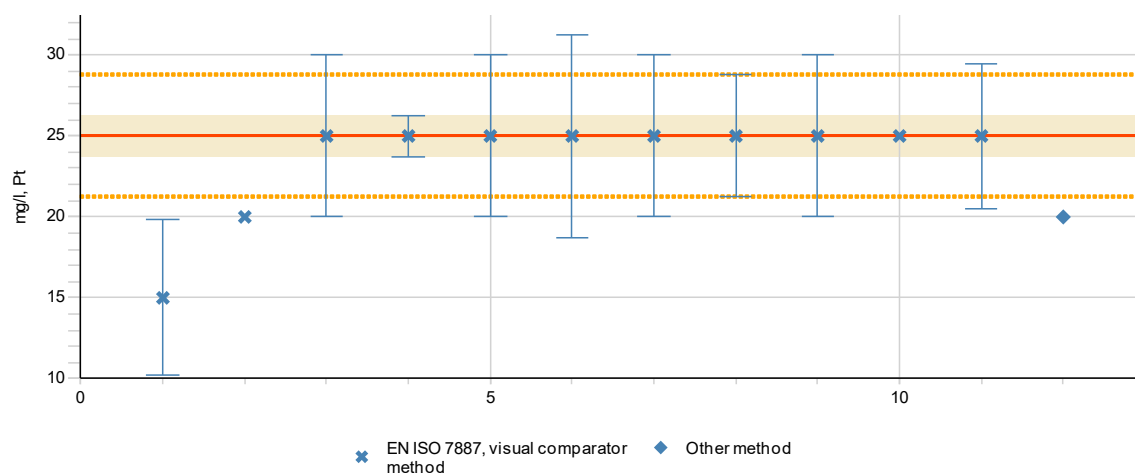
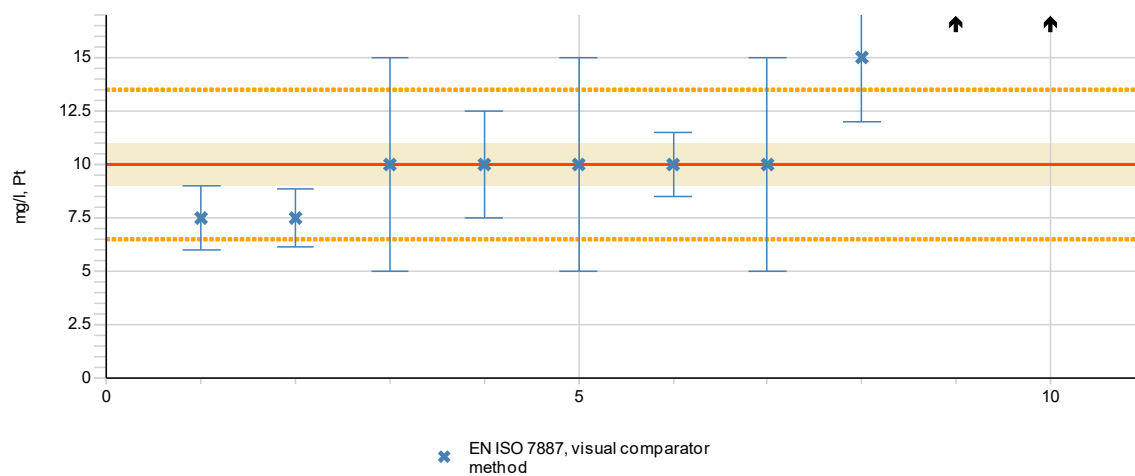


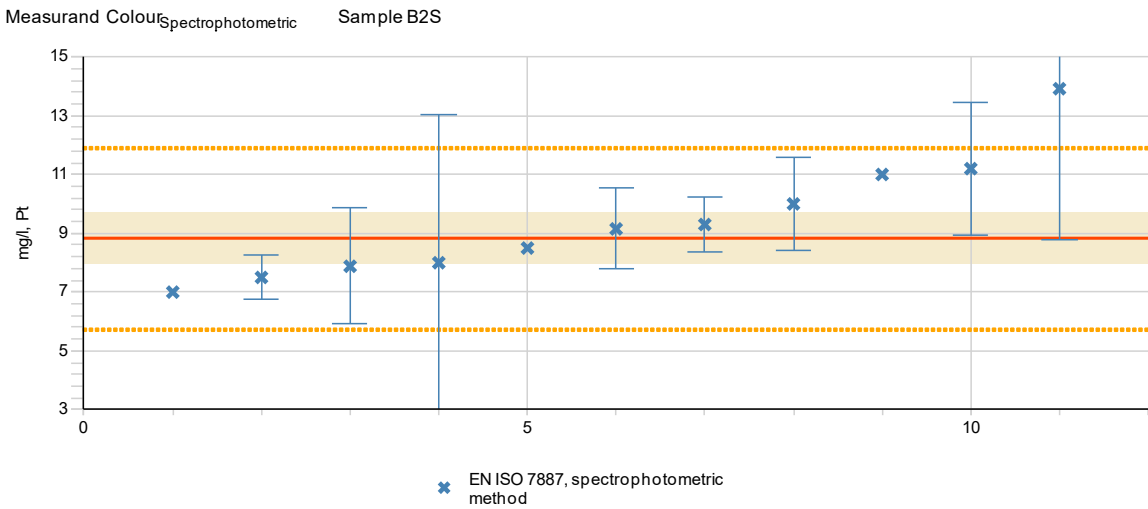
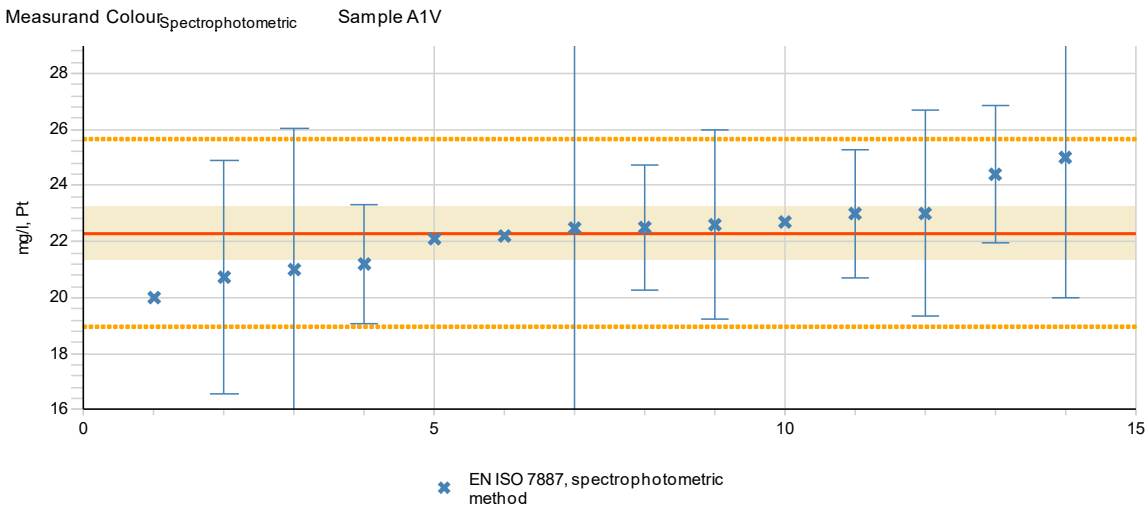
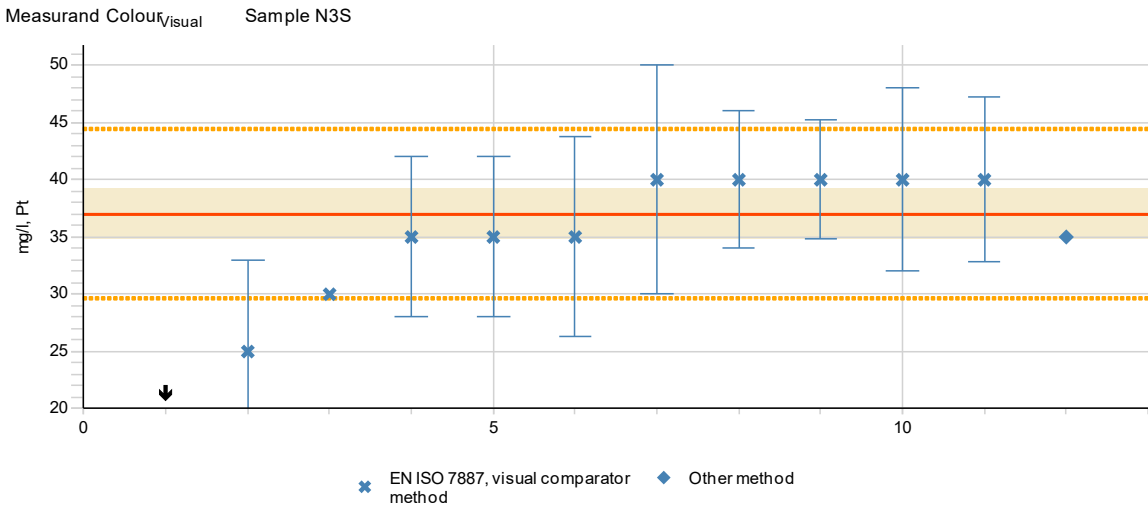
Appendix 12. Results grouped according to the methods

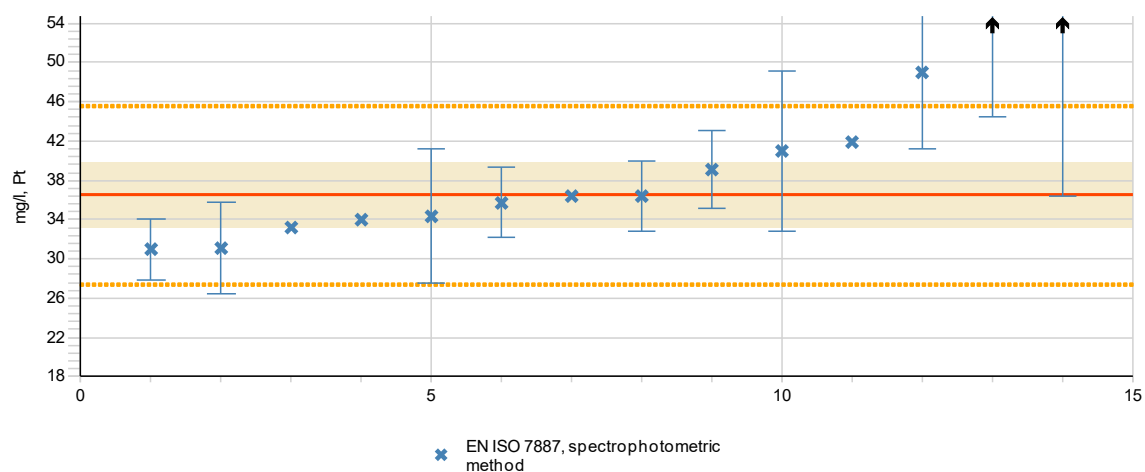
The explanations for the figures are described in the Appendix 9. The results are shown in ascending order.



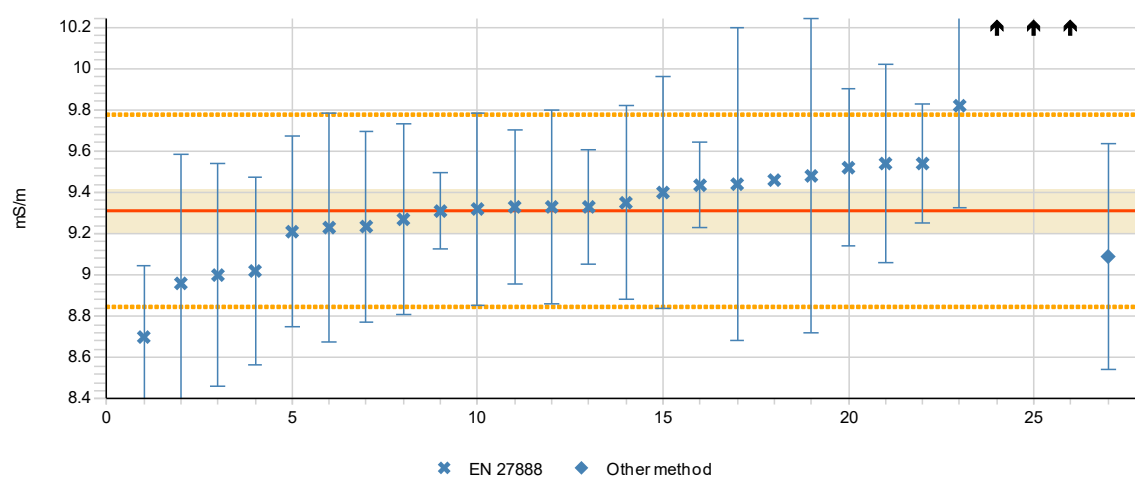
Measurand Chlorophyll a Sample N3K

Measurand Colour<sub>visual</sub> Sample A1VMeasurand Colour<sub>visual</sub> Sample B2S

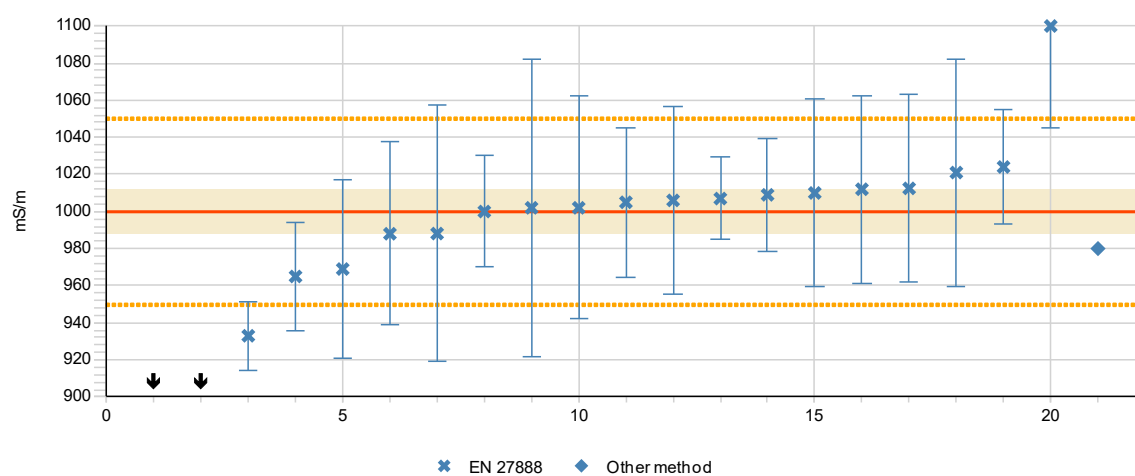


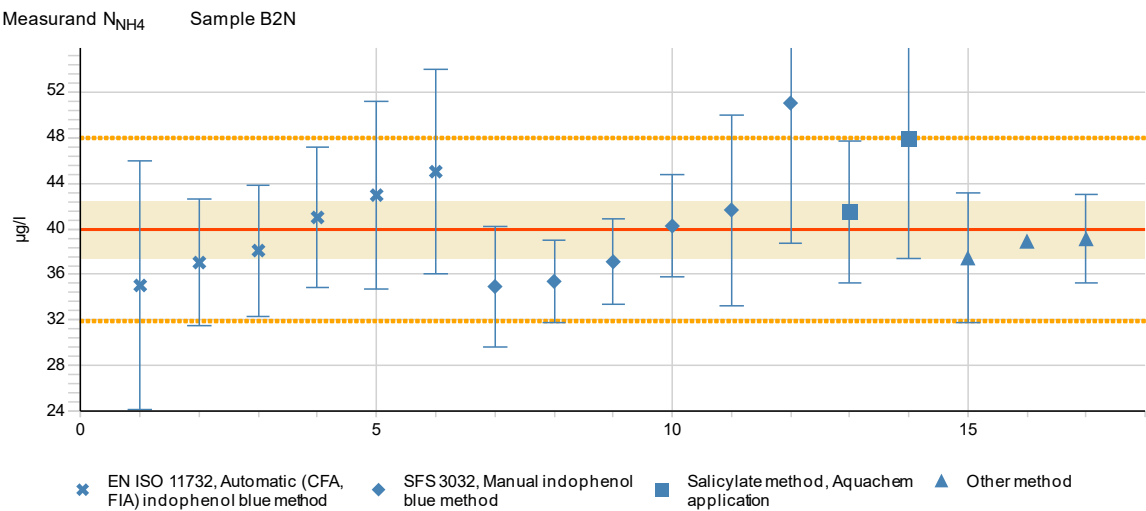
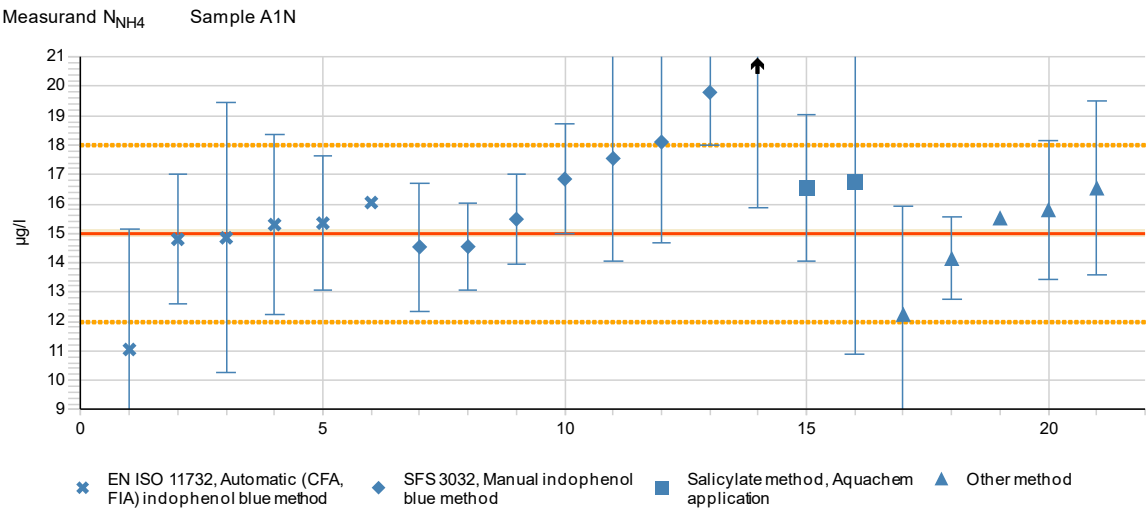
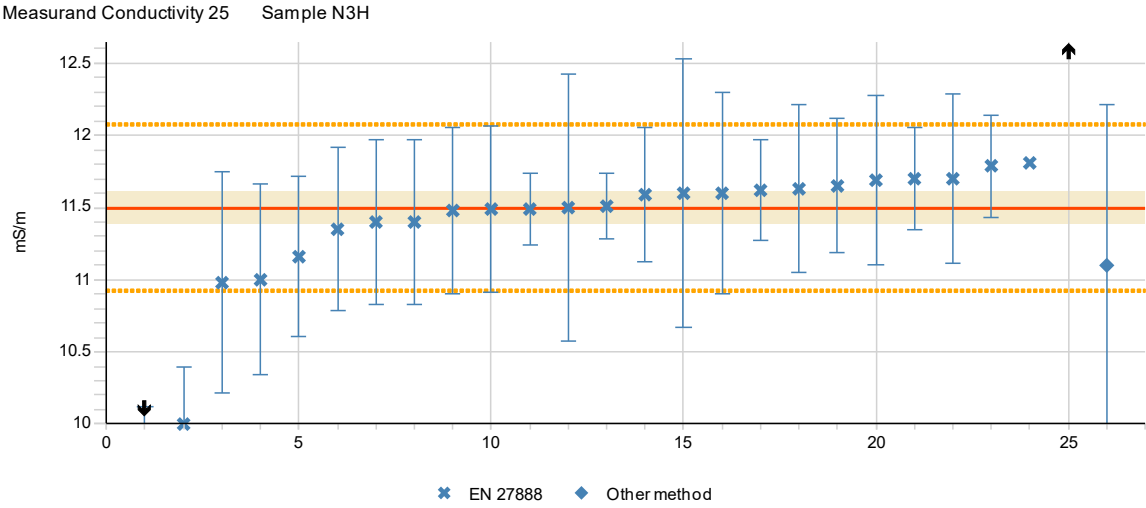
Measurand Colour<sub>Spectrophotometric</sub> Sample N3S

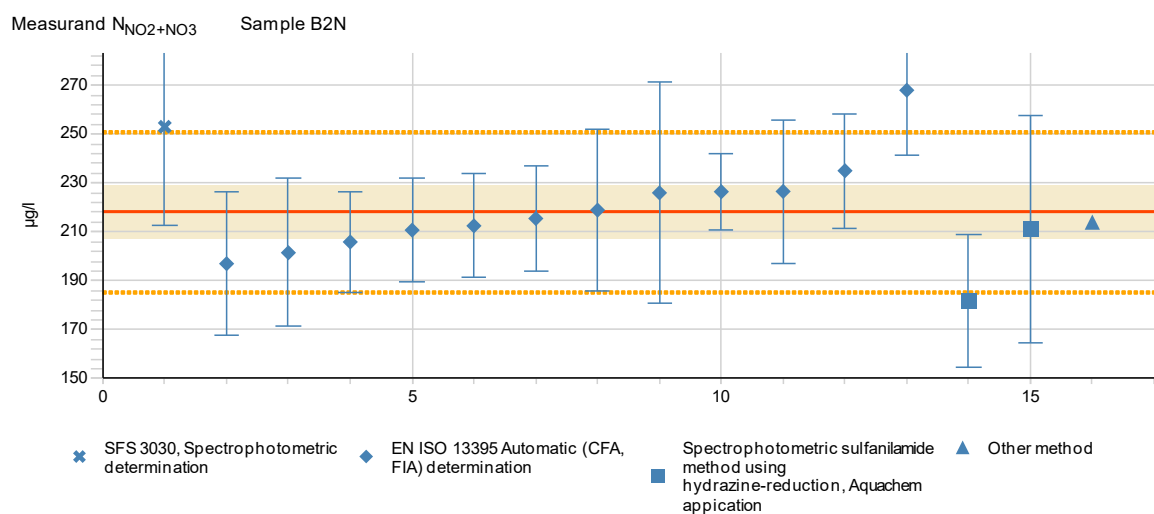
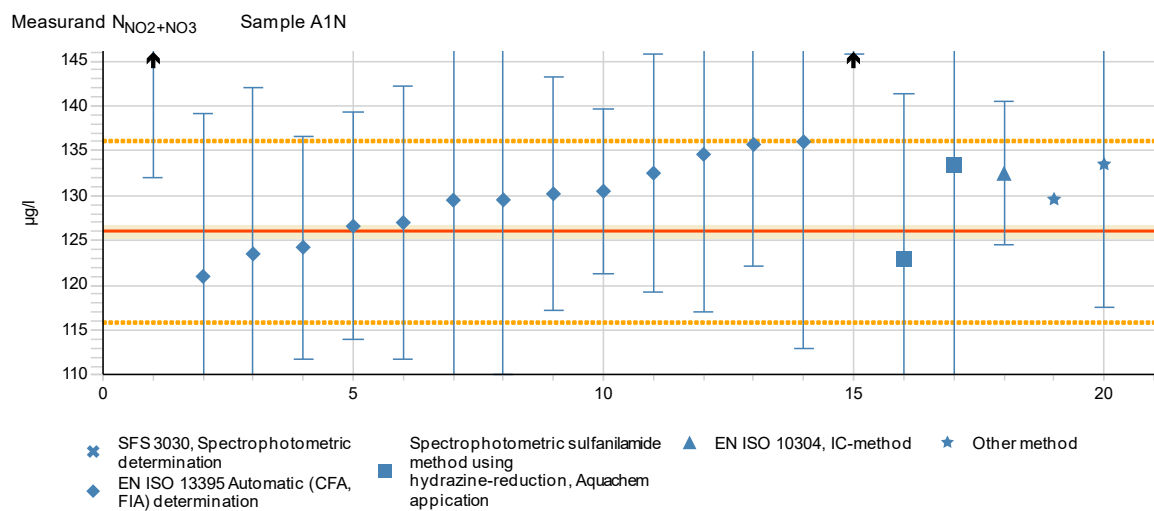
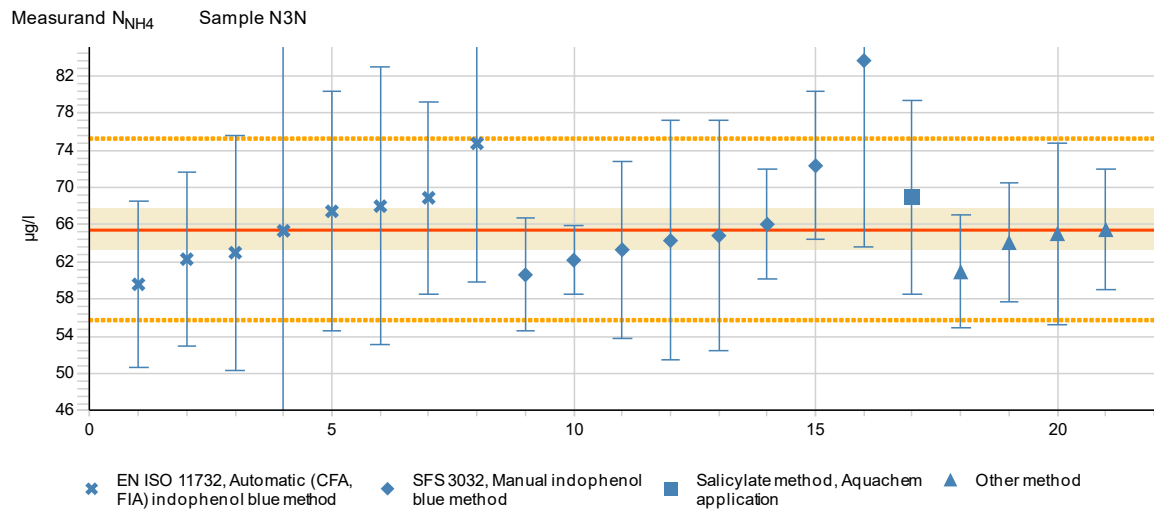
Measurand Conductivity 25 Sample A1J

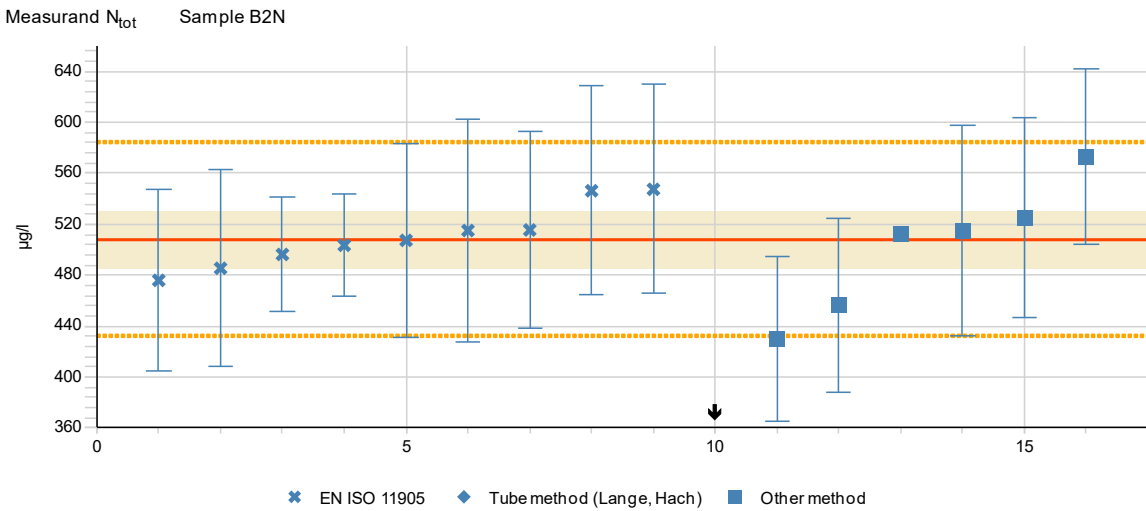
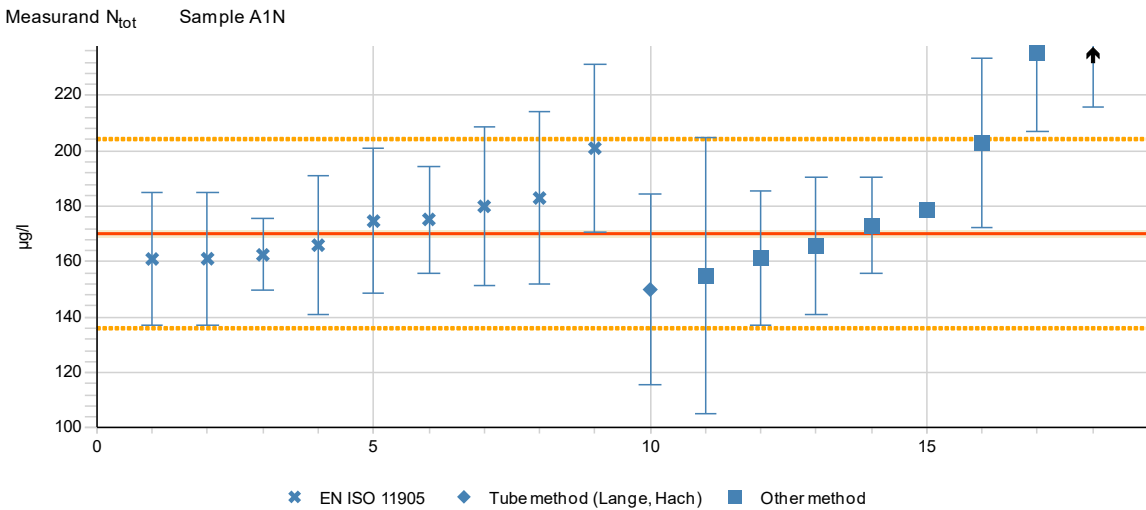
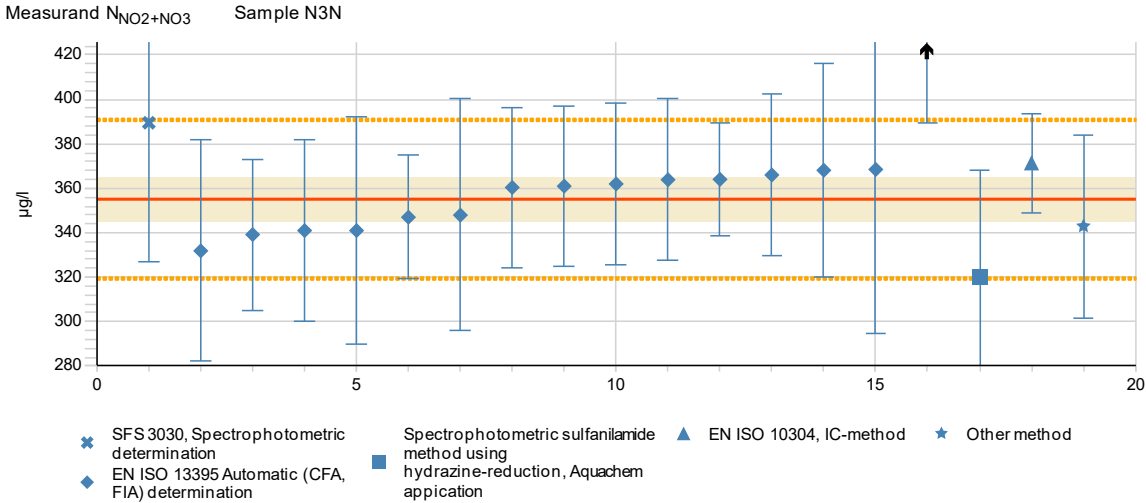


Measurand Conductivity 25 Sample B2H

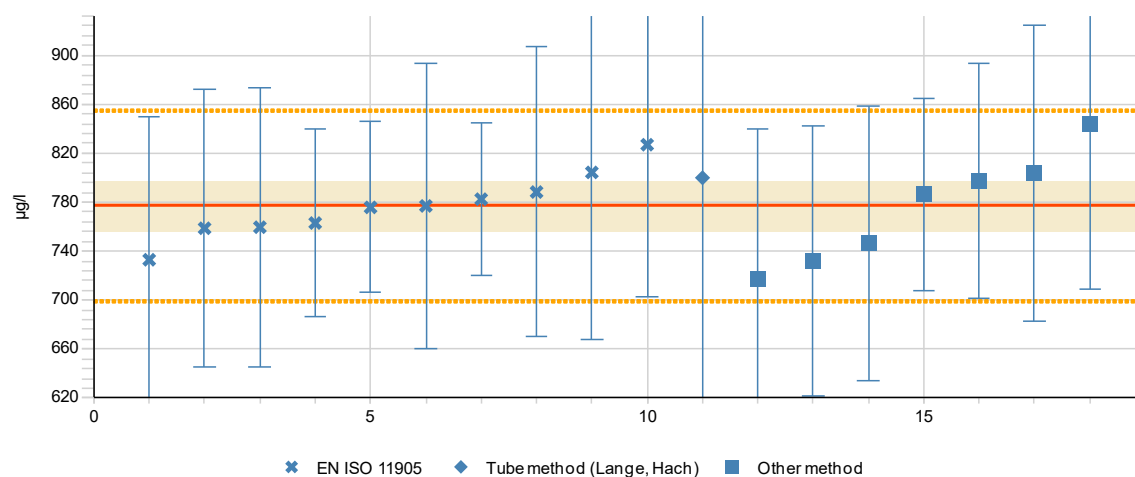




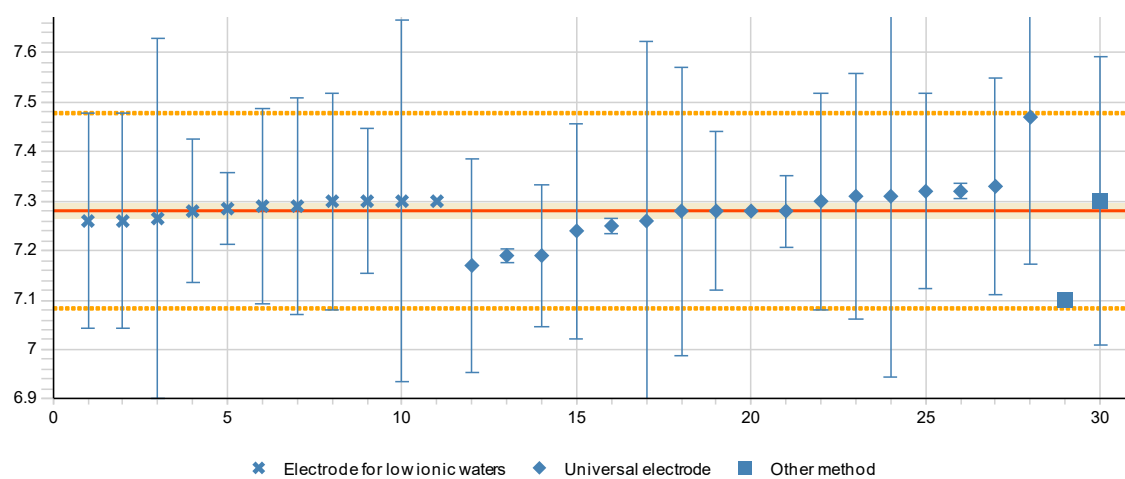




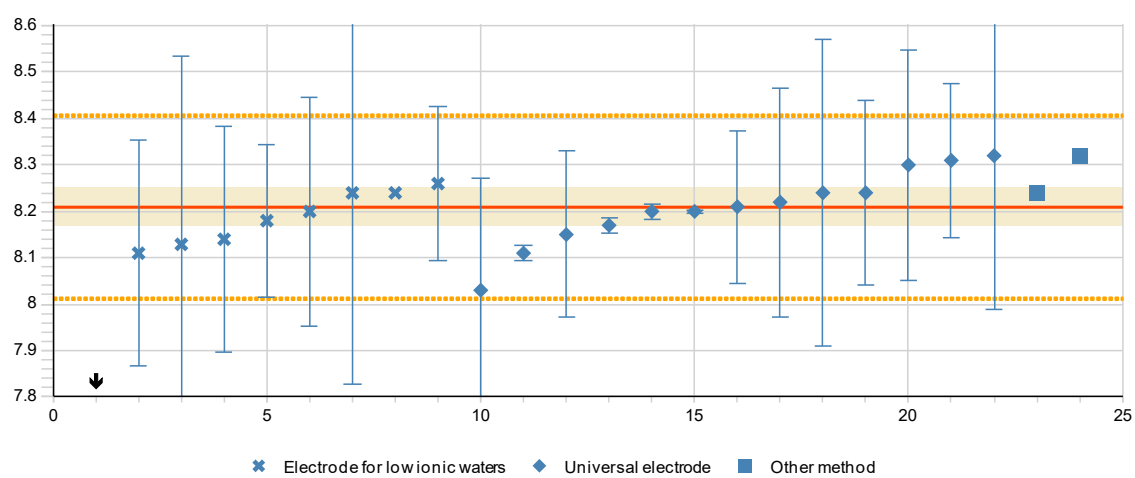


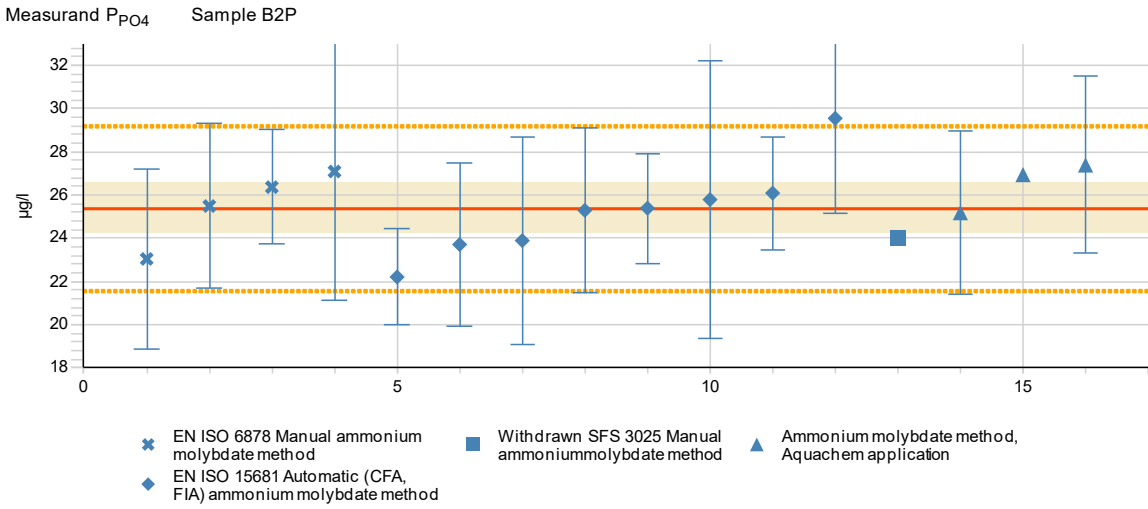
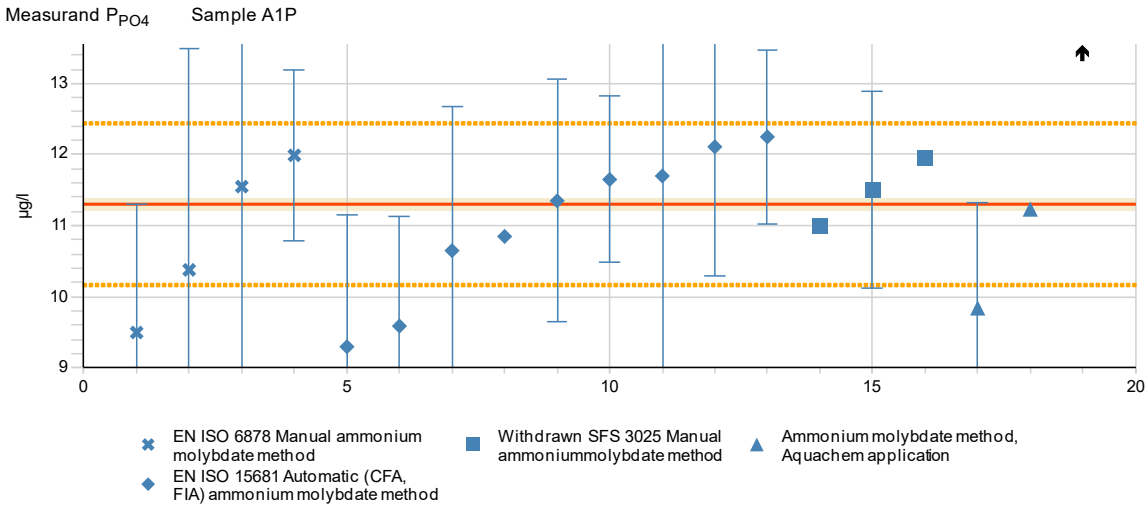
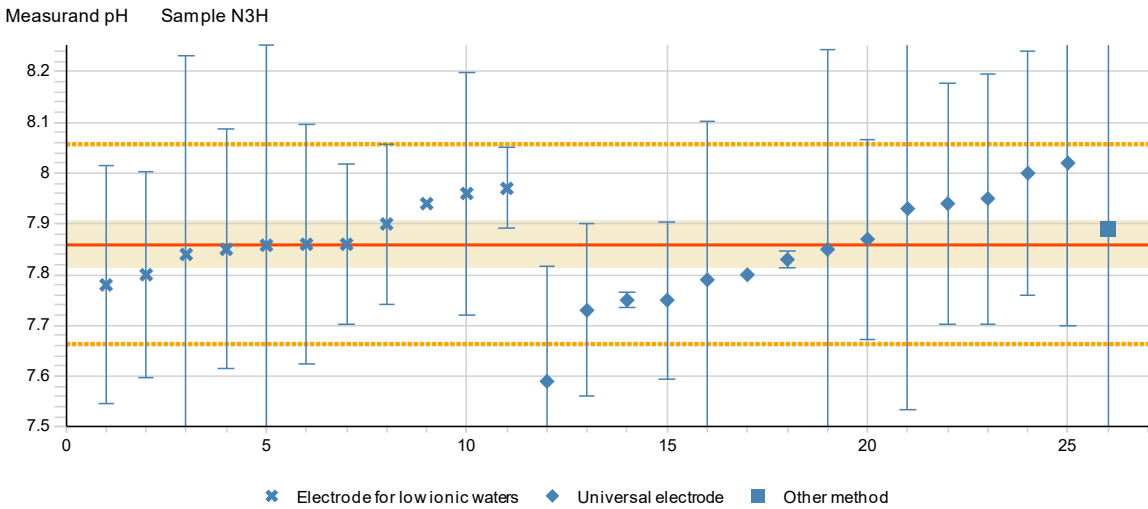
Measurand  $N_{\text{tot}}$  Sample N3N

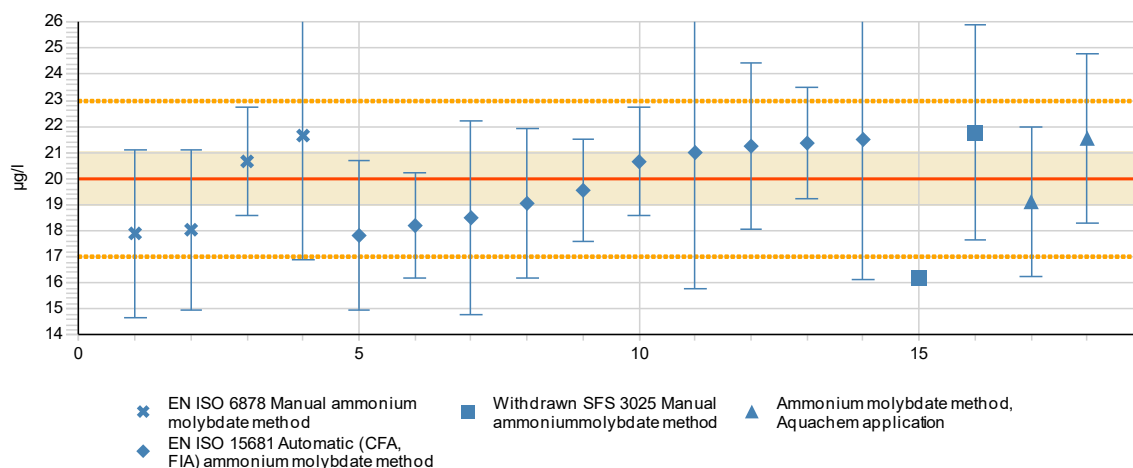
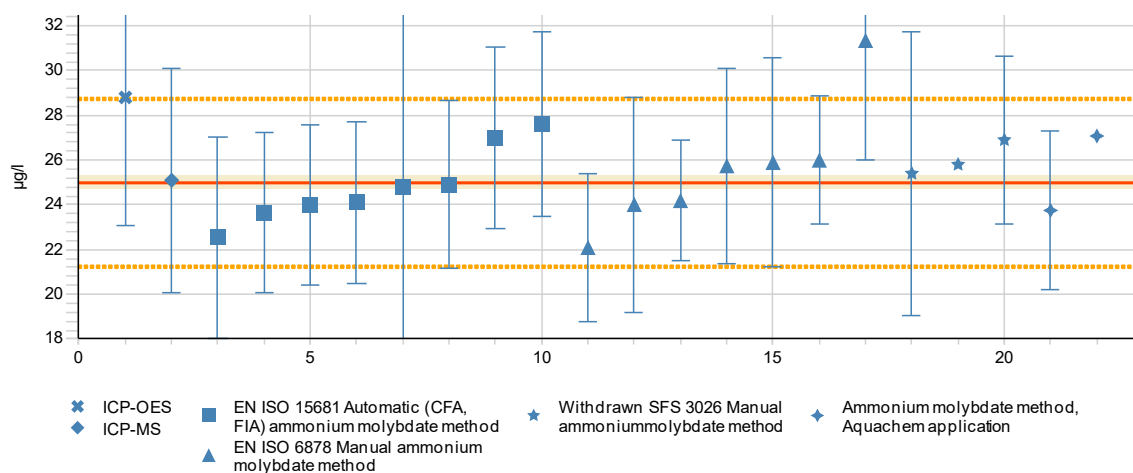
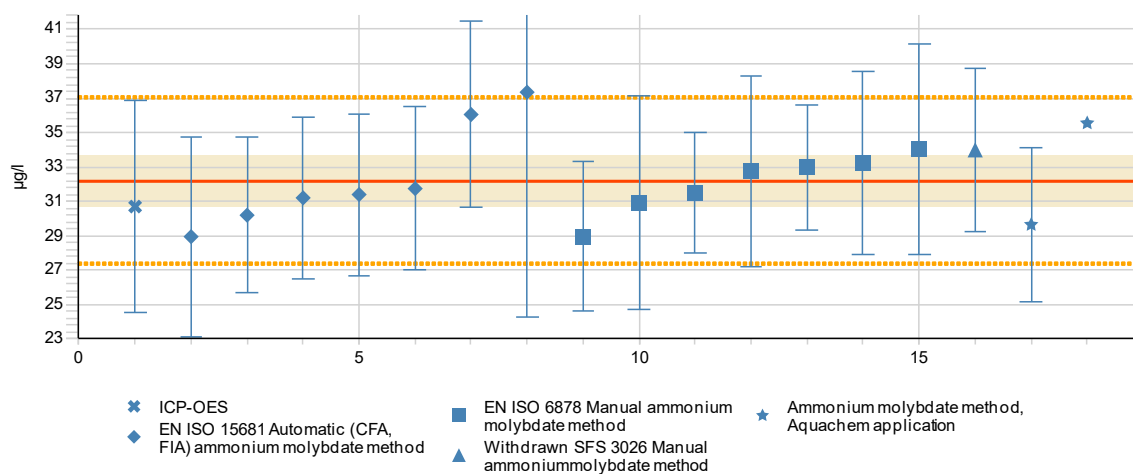
Measurand pH Sample A1H

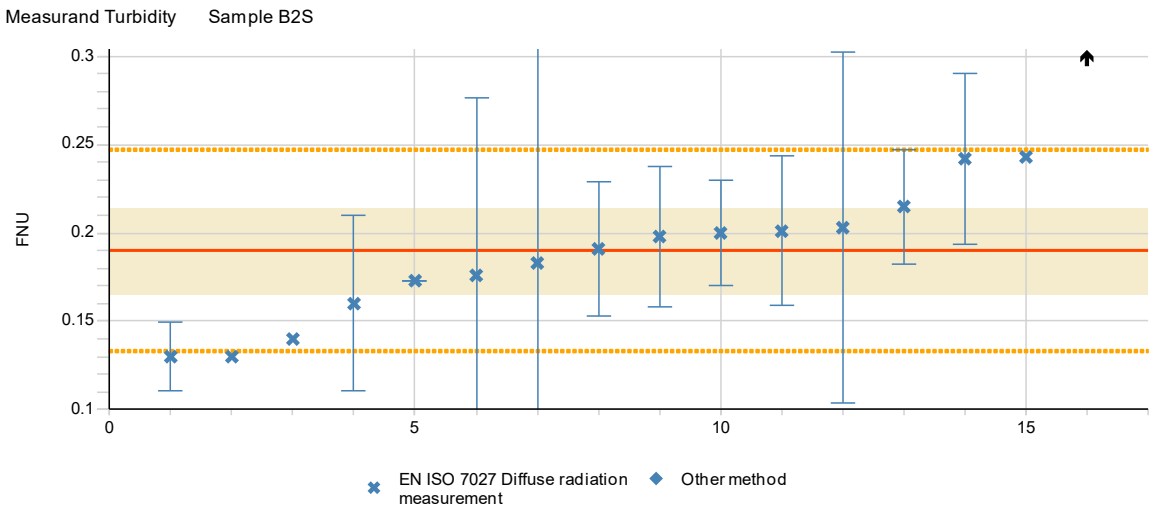
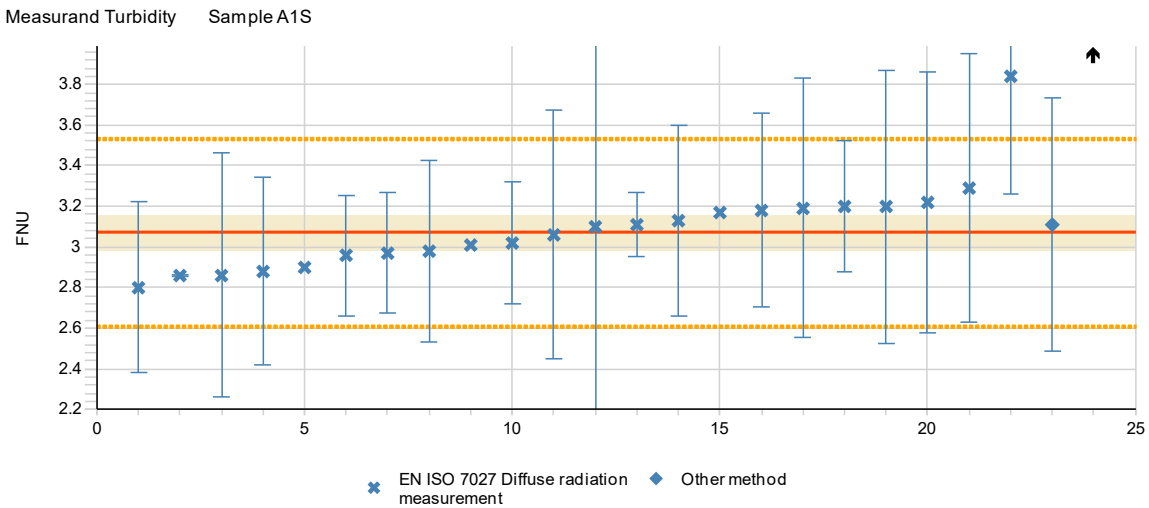
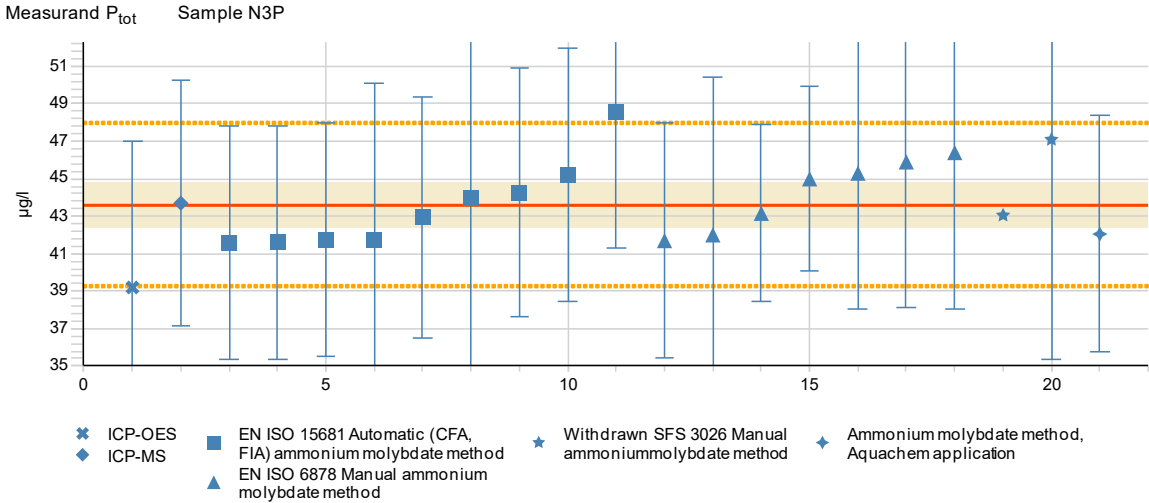


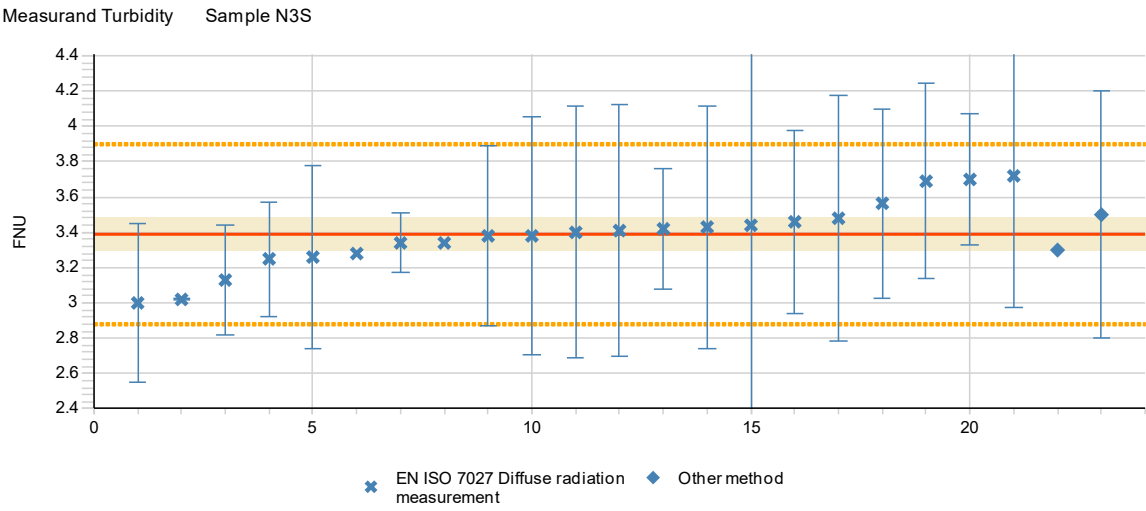
Measurand pH Sample B2H





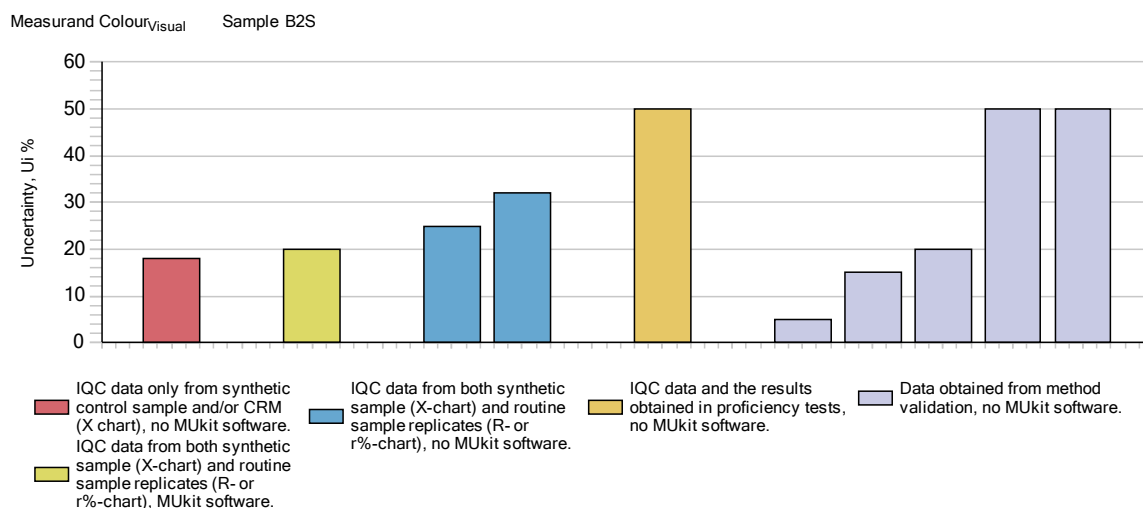
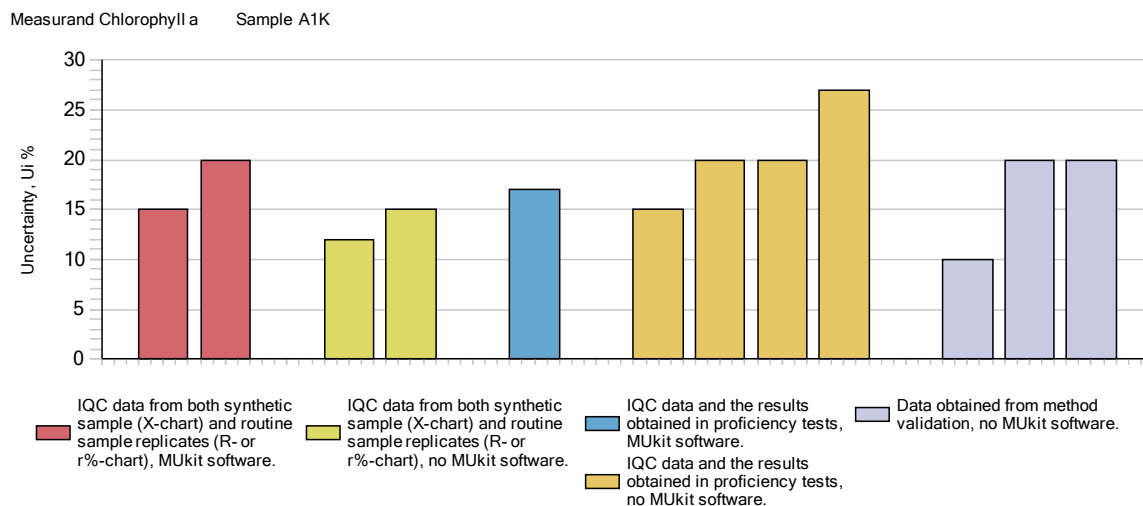
Measurand  $P_{PO_4}$  Sample N3PMeasurand  $P_{tot}$  Sample A1PMeasurand  $P_{tot}$  Sample B2P

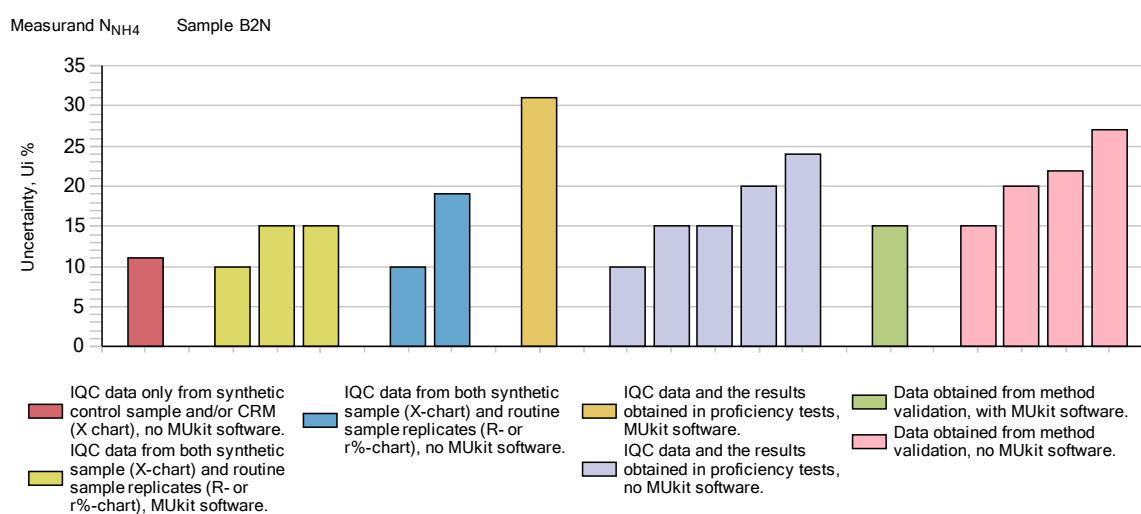
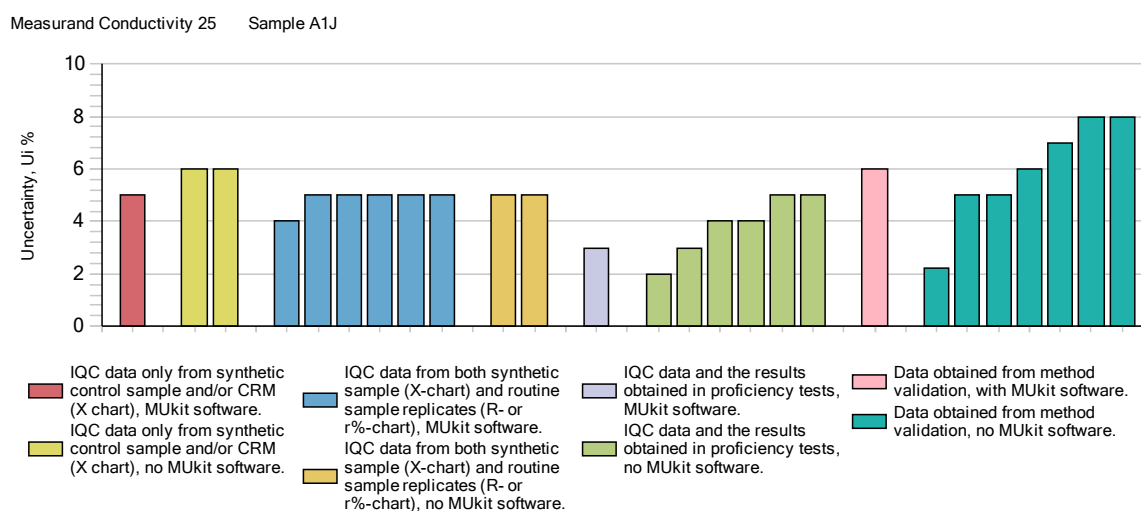
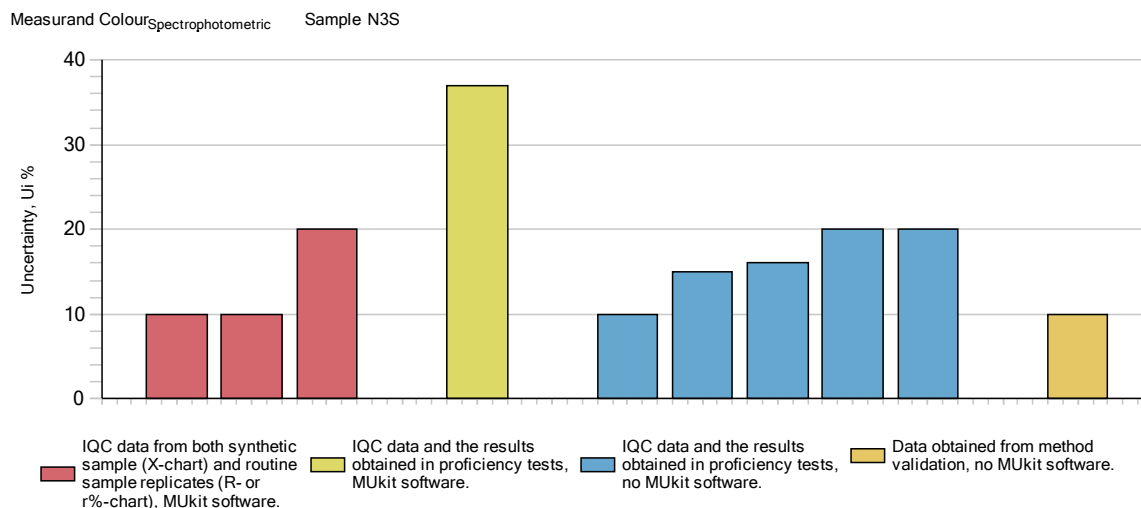




## Appendix 13. Examples of measurement uncertainties reported by the participants

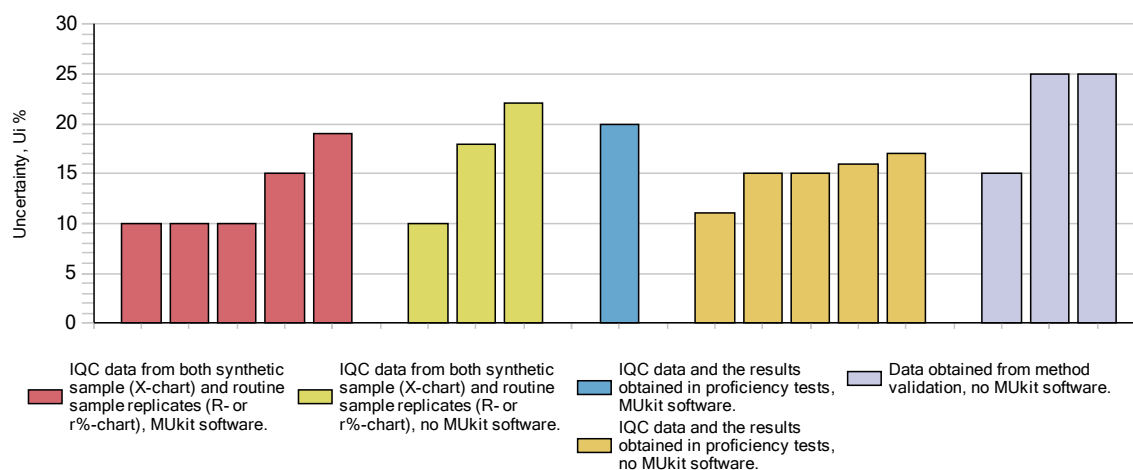
In figures, the presented expanded measurement uncertainties are grouped according to the method of estimation at 95 % confidence level ( $k=2$ ). The expanded uncertainties were estimated mainly by using the internal quality control (IQC) data. The used procedures in figures below are distinguished e.g. between using or not using the MUKIT software for uncertainty estimation [6, 7].



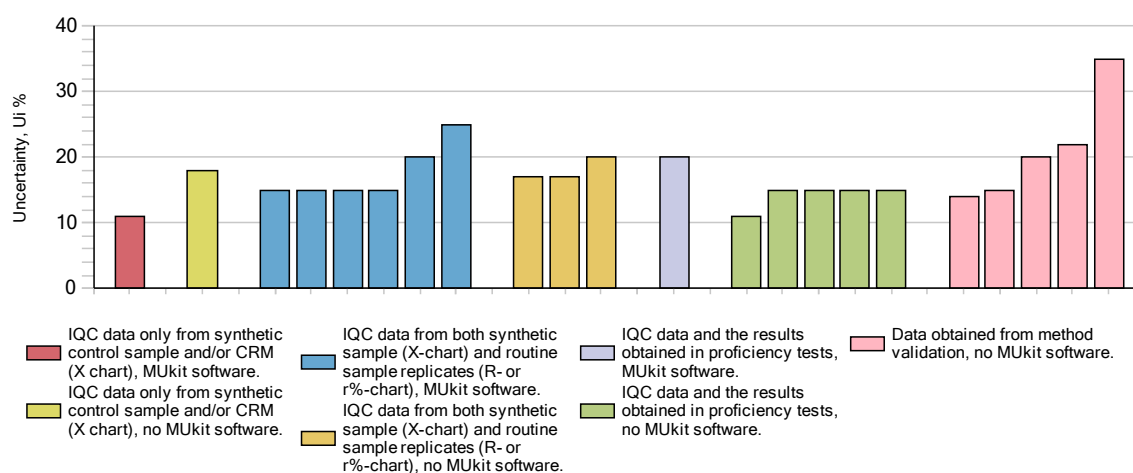




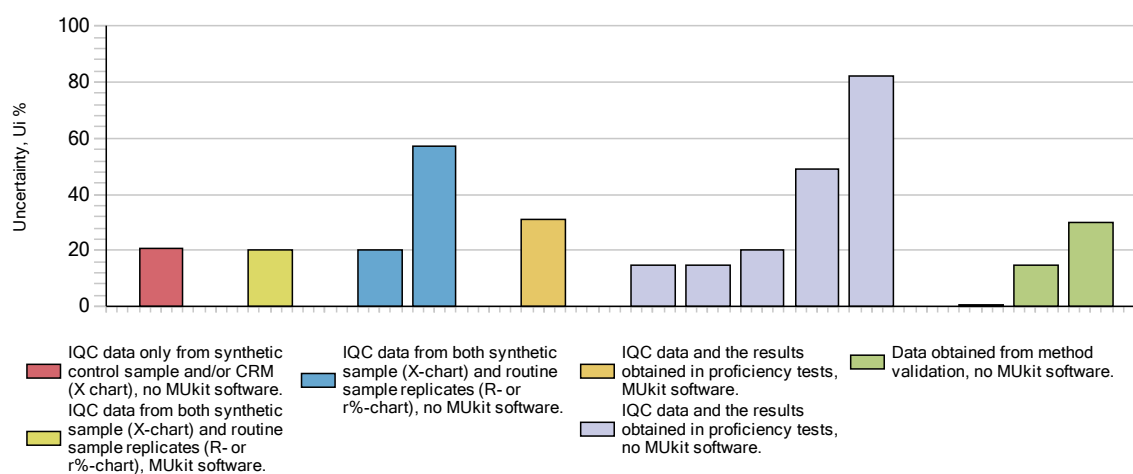


Measurand P<sub>PO4</sub> Sample N3P

Measurand $P_{\text{tot}}$	Sample A1P
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Measurand Turbidity	Sample B2S
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